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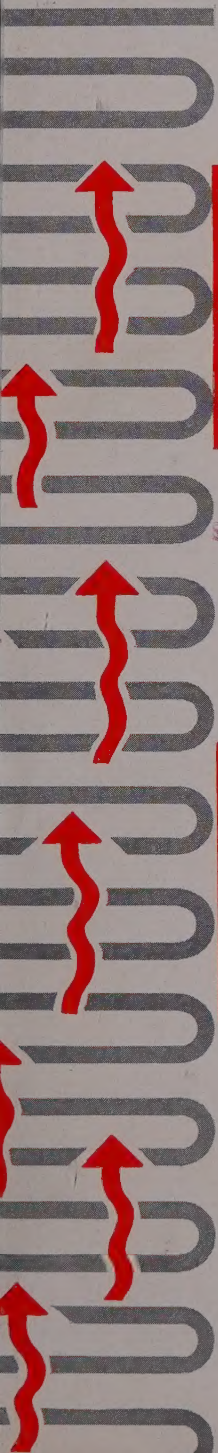

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ELECTRIC SPACE HEATING 1960

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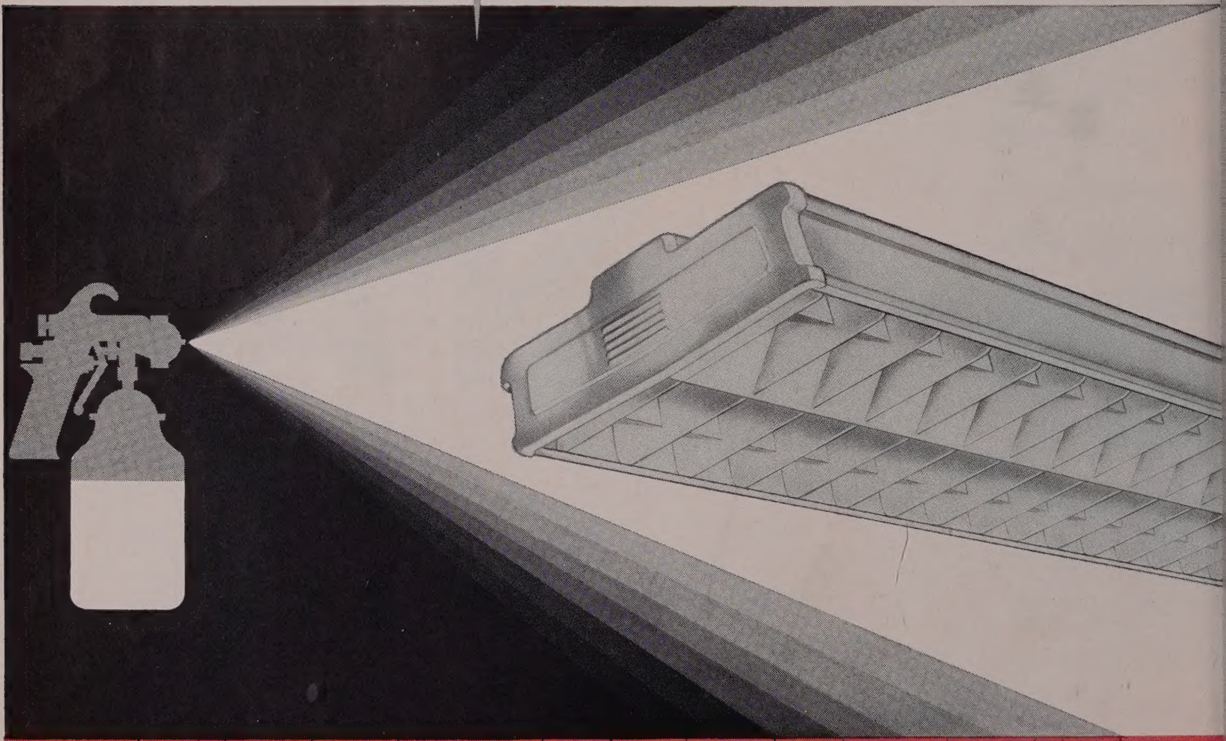

	Adhesion To Metal	Humidity Resist.	Salt Spray Resist.	Fume Resist.		Stain Resist.	Grease Resist.	Hardness	Mar Resist.	Reoperated Adhesion	Baking Color Stability	Heat Resist. (1)	Color Reten. Exposed to Ultraviolet
				Grease	Tobacco Smoke								
GOOD QUALITY FINISHES	8.0	8.5	8.5	7.5	6.5	5.0	7.0	8.0	8.5	8.5	7.5	5.0	6.0
NEW GUTH LUCITE* FINISH	9.5	10.0	9.5	8.5	9.0	9.0	10.0	22.0	9.5	10.0	8.5	9.0	9.0
PERCENT BETTER	18.75%	17.65%	11.76%	13.33%	38.46%	80.00%	42.86%	175.00%	11.76%	17.65%	13.33%	80.00%	50.00%

(1) 30 min. at 400° F. * ® DuPont

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ONLY VISIBLE BLADES GIVE YOU SAFETY YOU CAN SEE!

• The men who pull the switches will tell you what can happen when a switch, *believed* to be open —*isn't*. A lot of things can happen—and every one of them is bad. Personnel safety is in jeopardy. Motors can single-phase. Machinery and work can be damaged. Down-time can skyrocket.

Doesn't it make sense to insist on **V**isible **B**lade construction which gives you a road block against any of those possibilities? Doesn't it make equally good sense to insist on the safety switch which gives you that construction—plus a lot of other performance advantages? Evidently it does, because *Square D switches have never been out of first place in more than 50 years!*

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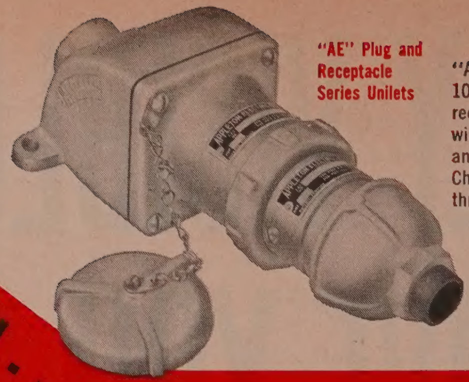
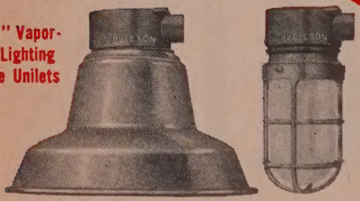


"AE" Plug and Receptacle Series Unilets

"AE" Series 30, 60, and 100 ampere plugs and receptacles come equipped with solderless connectors and replaceable interiors. Choice of lift cover, or threaded cap types.

"V-51" Vapor-Tight Lighting Fixture Unilets

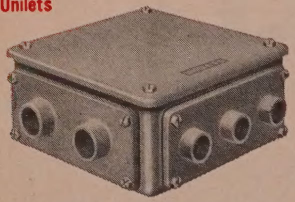


Vapor-tight lighting fixture series for use with rigid conduit. Known for its patented unit construction. Reflector and guard can be put on and taken off quickly . . . without tools! Designed for easy installation plus simple maintenance.

APPLETON®

Malleable Iron UNILETS®

"RS" Series Malleable Unilets



A universal junction Unilet box permitting flexibility of hub arrangements for easy adaptation in the field. Water-tight!

One of the most complete selections in the industry!

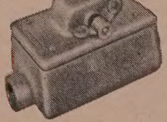
Yes, APPLETON can supply you . . . with a wide variety of Unilets for receptacles, switches, plain junctions, pilot lights, fixture hangers, etc. Ample wiring room. Assorted hub arrangements. *You name it, we've got it* . . . for indoors or out.

And every APPLETON product is made to the rigid quality standards pioneered by APPLETON engineers. They are easy to wire, are blemish free, have clean, chamfered threads conforming to N.P.T. requirements assuring a tight joint and positive ground. Next time you buy, specify APPLETON!

"AL" Fixture Hanger Series Unilets

Two styles available . . . ball or cushion. Provides a perfectly aligned flexible suspension of electrical fixtures and allows a swivel to 20° in any direction.

"FS" and "FD" Series Unilets



Weather-proof housings for junctions, receptacles and switches . . . for use outdoors or in. One, two, three and four-gang styles.

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Threaded and no-threaded malleable iron series . . . taper threads . . . covers held by screws — will not vibrate loose . . . high quality finish . . . full line.

"JB" Series Vapor-Tight Unilets

With or without mounting lugs. 4 tapped holes and 2 close-up plugs or blank body without close-up plugs. ½", ¾" and 1" sizes for use as "E", "C", "T", or "X" bodies.

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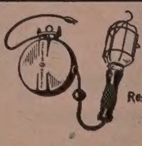
Explosion-Proof Lighting Fixtures

"Eagle Claw" Outlet Boxes

"ST" Series Connectors



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record . . . Established 1901

Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

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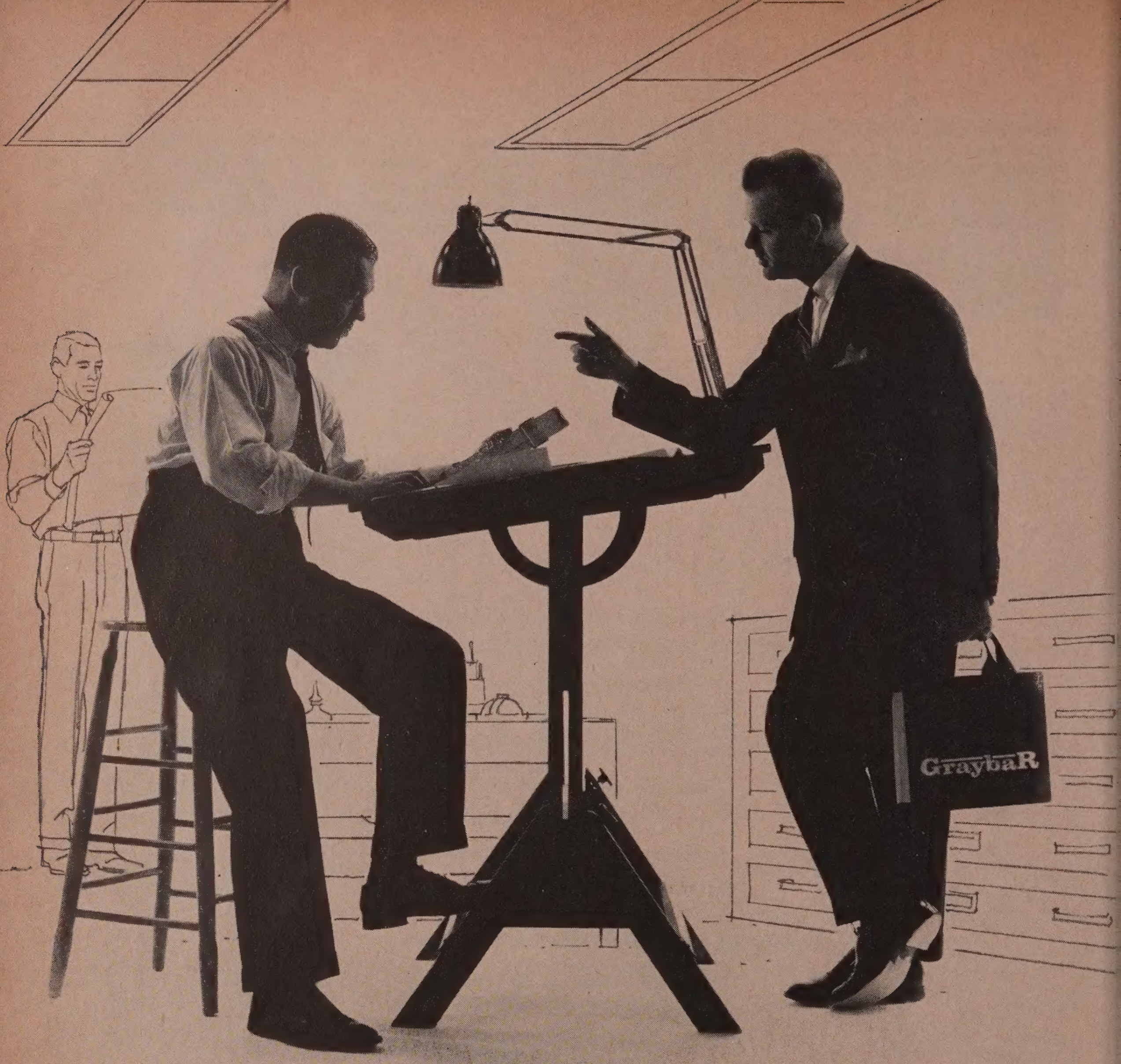
My Shop Is My Show Window 130

By A. L. DAVIS—Here's how one electrical contractor has lighted his new headquarters office to a maintained intensity of 150 footcandles —to show his clients the kind of lighting he wants to sell them.

Mercury Floodlighting Beautifies Famous Street 132

Special mercury floodlight units light trees and shrubbery on New York's famous Park Avenue. Installation was contributed as tribute to City's annual "Salute to the Seasons."

MORE



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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Garfield, New Jersey

Washington Report

MARCH • 1960

January new construction spending totaled $3.7 billion, a drop of 8% from the December level, but approximately the same as in January 1959. All types of construction held steady, or showed a small gain over year-earlier rates, except for new residential building, which declined 3%, and highway spending. Private construction spending was up 6%, but publicly financed construction spending was down by 12%—more than half of which was due to a 20% drop in highway spending.

Total nonfarm housing starts last year, at 1,377,000 dwelling units were 14% above housing starts in 1958, and almost equal to the 1950 record of 1,396,000 units. The dollar value of new dwelling units started in 1959 was $17,116 million, compared with $13,552 million in 1958, or up 26%. Dollar value of new dwelling units in 1950, record year for new starts, was $11,525 million. The 48.3% increase in dollar volume last year, over 1950, is due in part to inflation of the dollar, and in part to an increase in unit costs of homes.

Electric power output surged to a new record of 14,523 million kwhr in the week ended January 23rd this year. This was a gain of 8.4% over the similar week a year earlier. Cold weather and increased industrial activity were credited for much of the increase, according to Edison Electric Institute, although all geographic areas reported gains, with increases ranging from 4.4% in the West Central region to 13.1% in the Pacific Northwest.

Steel output in January set a record for any month and for the first time crossed the 12-million tons per month production mark, when output reached 12,043,000 net tons. This was also an increase of 29.3% over January 1959, a year earlier. Total steel shipments in 1959 were reported at 69,377,067 tons, up 16% compared with 59,900,000 tons in 1958, despite the steel strikes which closed down most of the industry for more than 3½ months last year.

U. S. copper output rose sharply in January when production totaled 75,768 tons, compared with 35,281 tons in December. Resumption of operations at some of the struck mines and refineries were credited for the increase.

Eleven Atlas ICBM bases are scheduled for completion within two years, located at various sites across the country. Each will cost about $47 million, and house a 10-missile squadron.

Interest costs on the Federal debt will soar $1.7 billion higher to $9.4 billion in the current fiscal year as compared with fiscal 1959, according to President Eisenhower's Economic Report, and increase again in fiscal 1961 to $9.6 billion. In each of these two years, interest payments alone will exceed total Federal expenditures in any year prior to 1941.

Industrial activity in January broke all records when the FRB Index rose to 169, up from 165 in December and 3 points above the previous high of June 1959.

Personal income hit a new annual rate in January of $393.3 billion seasonally adjusted, up from $392.1 billion annual rate in December, Dept. of Commerce reported. This compares with an Administration forecast of $402 billion for 1960 as a whole. Personal income in 1959 totaled $380.2 billion.

Employment at mid-January was 64 million, a record for this period, Labor Dept. reported, while unemployment rose by 600,000 to a total of 4.15 million.

Sidelights

Electric Heat

The rapid development of electric space heat technology and application has been well recorded here during the past few years. From time to time, however, it is necessary to recapitulate the essentials in a comprehensive editorial treatment that can be used immediately as a practical and up-to-date manual for current work. This is the objective of a special report, complete in this issue, "Electric Space Heating 1960" beginning on page 93. Preparation was scheduled to permit publication in this issue which reaches you shortly before the important Electric Home Heating Exhibition and Symposium convenes in Chicago. If you attend the meeting, be sure to stop by our booth in the Exhibition Hall at the Sherman Hotel. Associate Editor W. J. Novak, author of the special report, and other members of our staff, will be on hand to greet you.

Shop Show Window

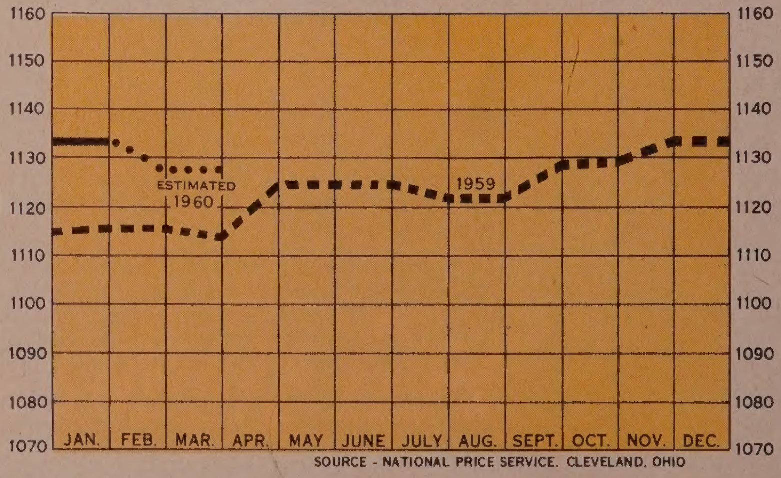
The electrical contractor's shop and offices are prime areas for practical demonstrations of modern lighting techniques. In planning the lighting of new quarters or modernizing existing facilities, it is easy to make the project a practical sales tool. Arthur L. Davis of A. L. Davis Company, Newark, N. J., electrical contractors and engineers, describes how his new headquarters office is lighted to a maintained level of 150 footcandles—to show his clients the kind of lighting he wants to sell them. His article, "My Shop is My Show Window" begins on page 130.

Special Project Ahead

Your May 1960 issue will be another outstanding "first edition." A major exclusive book-length editorial feature will bring together the full scope of current electrical construction practice. "Techniques of Modern Electrical Construction" will be a comprehensive manual covering methods and techniques for the installation of modern electrical systems. Emphasizing code requirements, it will present job-proven data on selecting, locating, mounting, connecting and protecting materials and equipment. Bearing mostly on physical installation, it is a logical complement to "Modern Electrical Systems Design" (May 1959) and has been prepared by the same team of engineer-editors who produced that popular and authoritative project. If your subscription is up for renewal or you wish to enter a new subscription, be sure to get your order in well in advance of the publication date. Because of the exceptional size and cost of the issue, only a small printing over the number required for subscriber service will be available.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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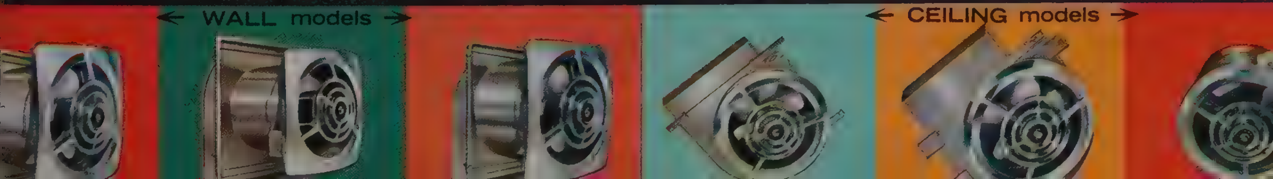

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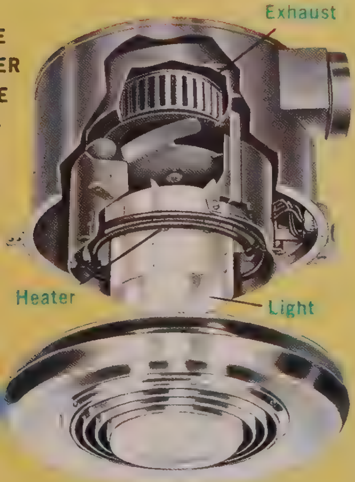


EW Model #9090 HEAT-A-VENTLITE

EW Model #[illegible] RADIANT HEATER

"We're 'sold' on concealed telephone wiring—and our customers are, too"

—says William B. Watkins, President
A. J. Watkins & Sons, Inc., Baltimore

This is one of the handsome custom homes in the "Pot Spring" community of suburban Baltimore.

In an unfinished model, builder Bill Watkins discusses a kitchen phone location with telephone man C. L. Anderson.

Your local Telephone Business Office will gladly help you with telephone planning for your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

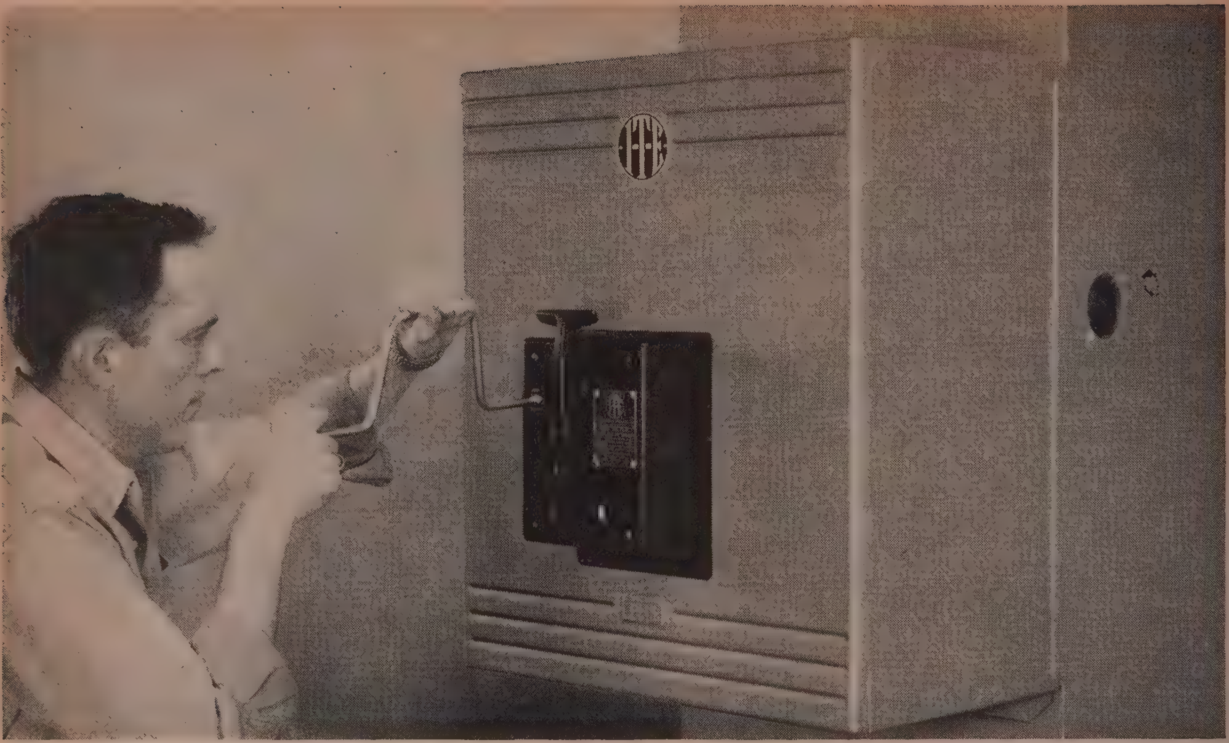
BELL TELEPHONE SYSTEM

A. J. Watkins & Sons, Inc., has built more than 4500 homes since World War II. The firm's current project is the "Pot Spring" community of homes north of Baltimore in historic Dulaney Valley.

Custom-built in the $35,000 to $40,000 range, these distinctive homes have one important feature in common: a minimum of six built-in telephone outlets with wiring neatly concealed in the walls.

"We've telephone planned over 200 of our homes—ever since the telephone company made concealed wiring available," says Bill Watkins, president of the firm. "Nowadays, people *ask* us about it. They consider it a necessary feature of a modern, quality-built home. It makes it easy for them to add extension phones whenever and wherever they need them.

"We're 'sold' on concealed telephone wiring—and our customers are, too. It definitely helps us sell our homes."



Urelite® gives you double safety

Exclusive with I-T-E

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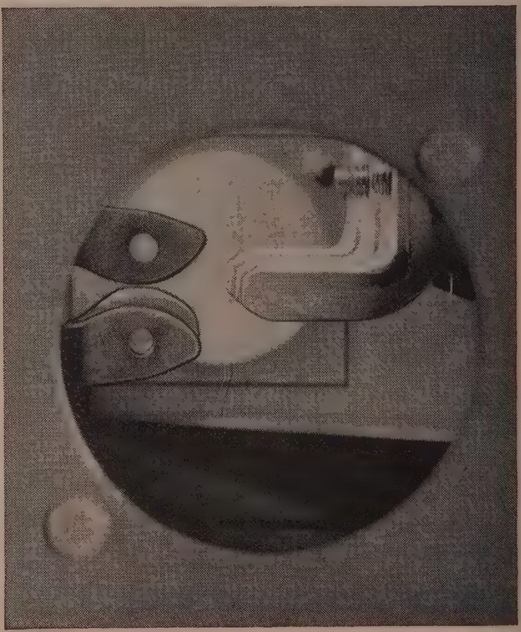
Visible separable contacts



In an individually enclosed large air circuit breaker, you couldn't ask for more safety than the I-T-E URELITE gives you. To disconnect it, just insert the crank at the front and turn. Cover need never be removed. A look through the side window positively shows you the position of the separable contacts. Also, with the circuit breaker open, it can be padlocked safely in either connected or disconnected position.

The whole truth is that URELITE breakers are unmatched for exclusive safety provisions, and for low-cost installation, easy access, longer contact life, and adjustable overload devices for higher loads. They handle circuits up to 600 volts, 15 to 4000 amp continuous and 150,000 amp interrupting. Write for new bulletin 4261-2B. I-T-E Circuit Breaker Company, Dept. LA, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

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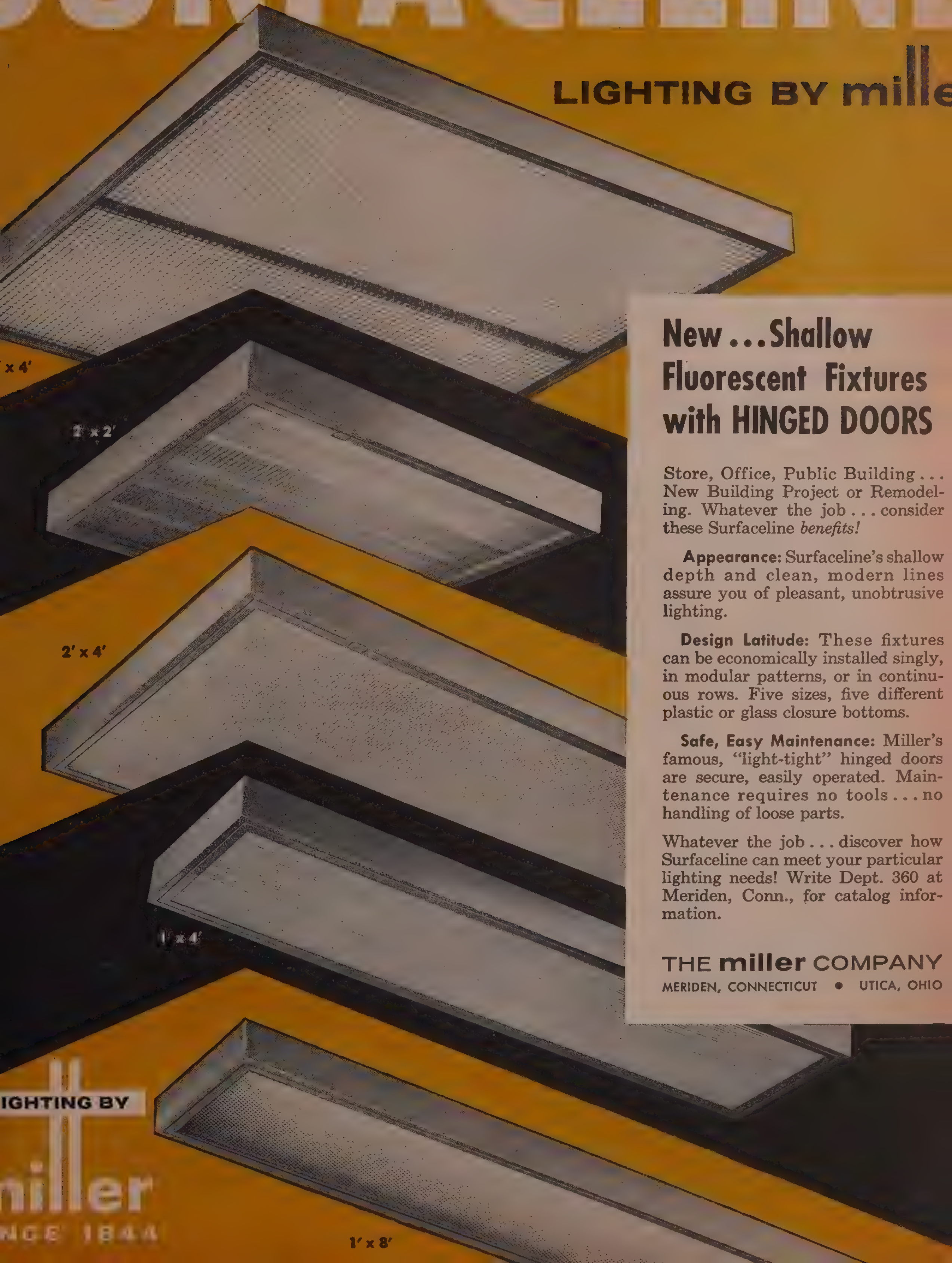

New . . . Shallow Fluorescent Fixtures with HINGED DOORS

Store, Office, Public Building . . . New Building Project or Remodeling. Whatever the job . . . consider these Surfaceline *benefits!*

Appearance: Surfaceline's shallow depth and clean, modern lines assure you of pleasant, unobtrusive lighting.

Design Latitude: These fixtures can be economically installed singly, in modular patterns, or in continuous rows. Five sizes, five different plastic or glass closure bottoms.

Safe, Easy Maintenance: Miller's famous, "light-tight" hinged doors are secure, easily operated. Maintenance requires no tools . . . no handling of loose parts.

Whatever the job . . . discover how Surfaceline can meet your particular lighting needs! Write Dept. 360 at Meriden, Conn., for catalog information.

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NO.

CONTROL

Now! A limit switch with more than twice the life of any other type made!

Cutler-Hammer's new oil tight limit switch cuts the biggest cause of machine tool electrical failures in half

Limit switch failure has caused more production down time than any other electrical component. Now, Cutler-Hammer has the best cure yet for this big industrial headache—the most reliable limit switch made.

Under test conditions so tough they'd never be equalled in actual production, it has lasted more than twice as long as the best of competition. Be sure to send for Pub. ED143-A200 for complete information.

Cutler-Hammer is on the move, and this new limit switch is just one of many examples.

You can see this new power in new products, in new engineering depth, particularly in industrial automation. Our Airborne Instruments Laboratory Division, for instance, adds electronic experience to the advanced control engineering which has put us into a position of leadership throughout the world. We've developed systems that automatically handle everything from charging a blast furnace to counting and stacking newspapers. We've added plants to give us more manufacturing capacity.

The new trademark you see here represents our new capability to help you meet the tremendous demands that you are going to face in the years ahead. We want to help you plan ahead so you can keep ahead.

Phone your nearest Cutler-Hammer office now and let us tell you our story.

WHAT'S NEW? ASK...

CUTLER-HAMMER

CONTROL

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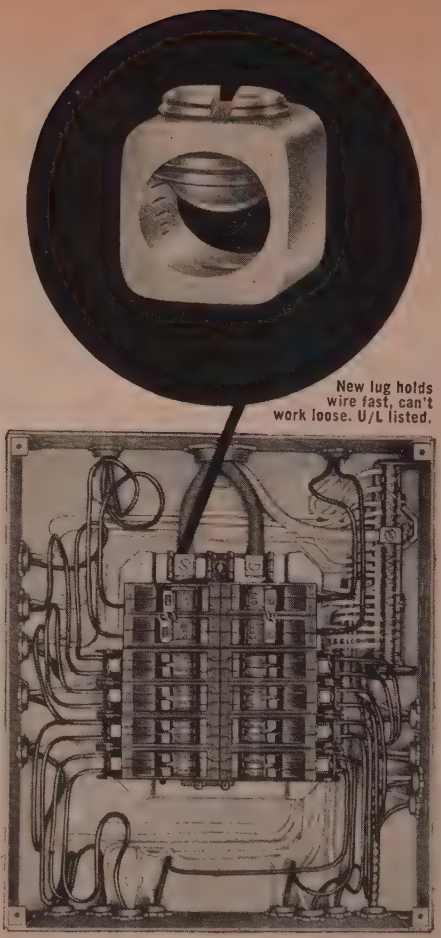
U/L LISTED

NEW! LUGS FOR BOTH COPPER AND ALUMINUM WIRE



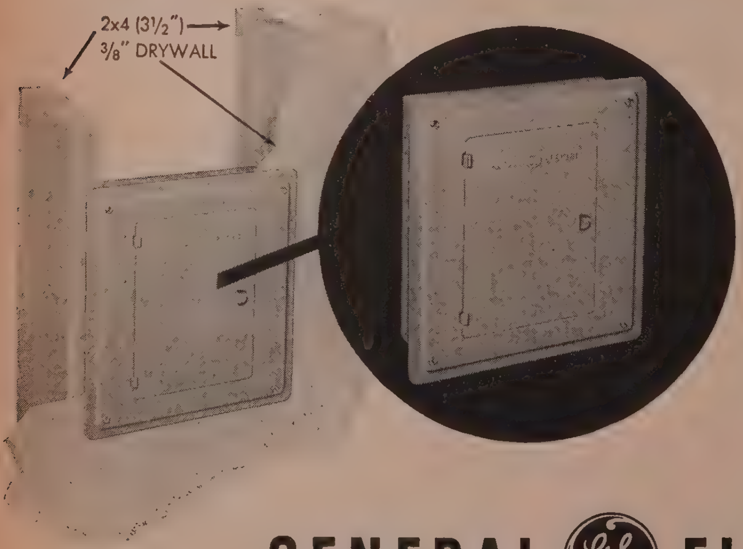
New lug holds wire fast, can't work loose. U/L listed.

All General Electric load centers (100† and 200 amp.) and fuse pullers (100 amp.) are now U/L listed for both copper and aluminum wire—thanks to the new lug shown above which is standard on these devices *at no extra cost.*

Add this feature to the many advantages of G.E.'s new "twin" breakers and you'll see why more and more contractors are switching to General Electric for highest quality at the lowest cost. The "twin"* lets you put two quality breakers in the space you usually take for one, use a smaller load center, and realize big savings on every job.

† Except TRM Series   * Trade-Mark

New G-E flush-front load centers fit flush even with 3/8" drywall



Here is a complete new line of flush-mounted General Electric "twin" load centers to answer your demands for equipment which fits flush with 2" x 4" studs and ⅜" drywall construction.

Ask your G-E distributor to show you the new *flush-front* load centers. Like all General Electric load centers, they feature Snap-Out interiors and provide automatic front alignment—even if the box is installed slightly off plumb.

GENERAL ELECTRIC

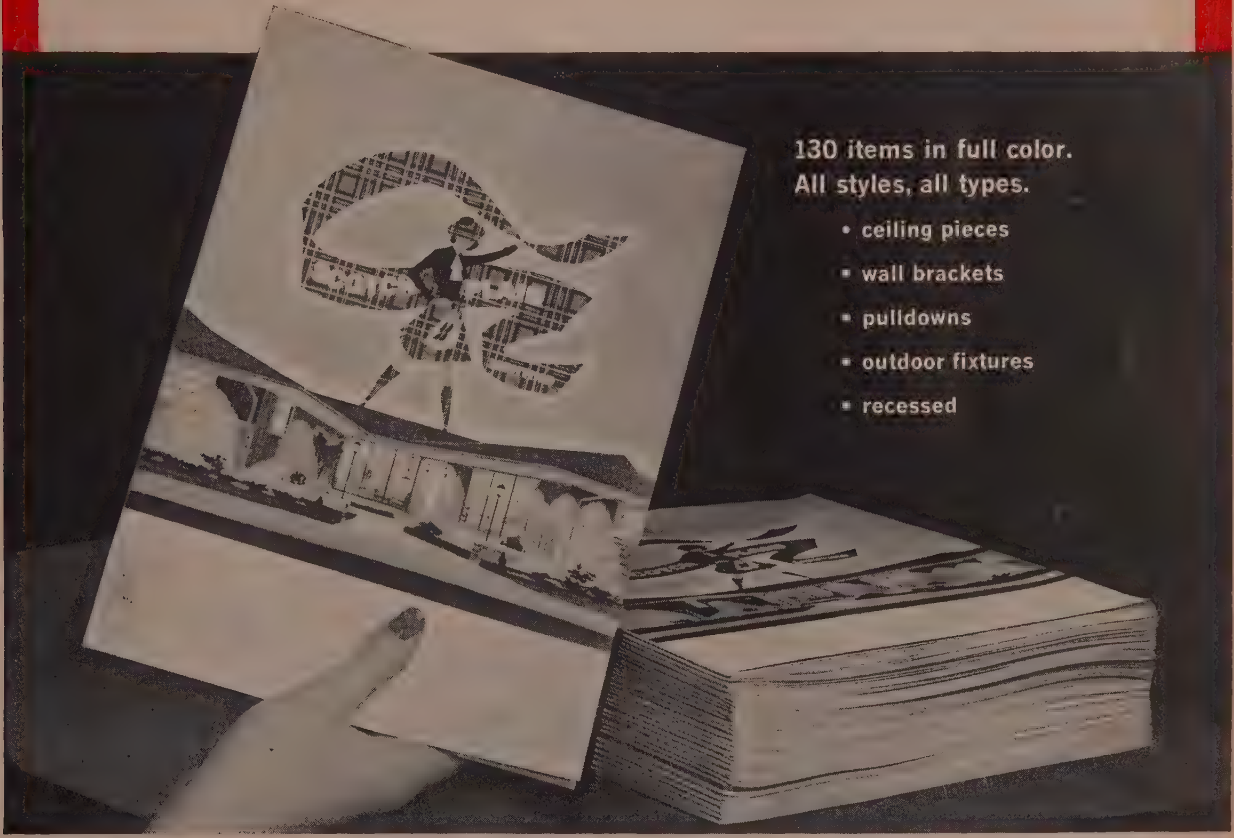
Circuit Protective Devices Dept., Plainville, Conn.

virden Presents the NEW line of

SCOTCH PLAID LIGHTING

Beauty *PLUS* Economy...

From Virden, famous for quality, comes a new and separate line of lighting fixtures. Called Scotch Plaid Lighting, here is beauty in design, excellence in workmanship, at a truly economical price! Ideal for tract homes or low-cost housing. Excellent for remodeling, wherever you want high-style at budget prices. See the new Scotch Plaid Lighting line at your nearby Virden distributor. Ask him for your copy of our new, free, full-color catalog. Or mail the coupon below.



130 items in full color.
All styles, all types.

- ceiling pieces
- wall brackets
- pulldowns
- outdoor fixtures
- recessed

See your Virden distributor or mail the coupon today!

VIRDEN LIGHTING

A Division of the John C. Virden Company
Cleveland 3, Ohio

Member American Home Lighting Institute

In Canada, John C. Virden Ltd., Toronto, Ontario

Virden Lighting, Dept. ECM-3
5209 Euclid Avenue
Cleveland 3, Ohio

Please send me your free Scotch Plaid Catalog SP-160.

Find It Fast In The Yellow Pages

Name ______________________________

Address ____________________________

City ____________________ State __________

Mr. Lester Olsen, Electrical Contractor for the Random Lake High School, Random Lake, Wis., says:

"Simplified wiring Clock System

Mr. Olsen stands beside the Honeywell Master Time and Program unit (ST 401, cover removed).

diagrams made the Honeywell a snap to install!"

Electrical Contractor: Lester Olsen; Olsen Electric of Wisconsin and Florida
Architect: Edgar A. Stubenrauch and Associates; Sheboygan
Engineer: Trester Engineering Company; Sheboygan and Milwaukee

Mr. Olsen found that installing the Honeywell Clock and Programming System at Random Lake High School was easy— thanks to Honeywell's concise, easy-to-follow engineering diagrams.

"We were pleased with the way Honeywell backs their Clock and Programming System with clear, concise wiring diagrams," says Mr. Olsen. "Our engineers had no installation problems whatsoever, and the entire job proceeded without a hitch."

Mr. Olsen adds: "By periodically checking installation procedures, Honeywell men helped us insure against costly wiring changes or corrections. What's more, we found the job of installing a Honeywell Fire Alarm System went smoothly, too. In fact, the same service and installation ease of the Honeywell Clock and Programming System is true of the Fire Alarm System!"

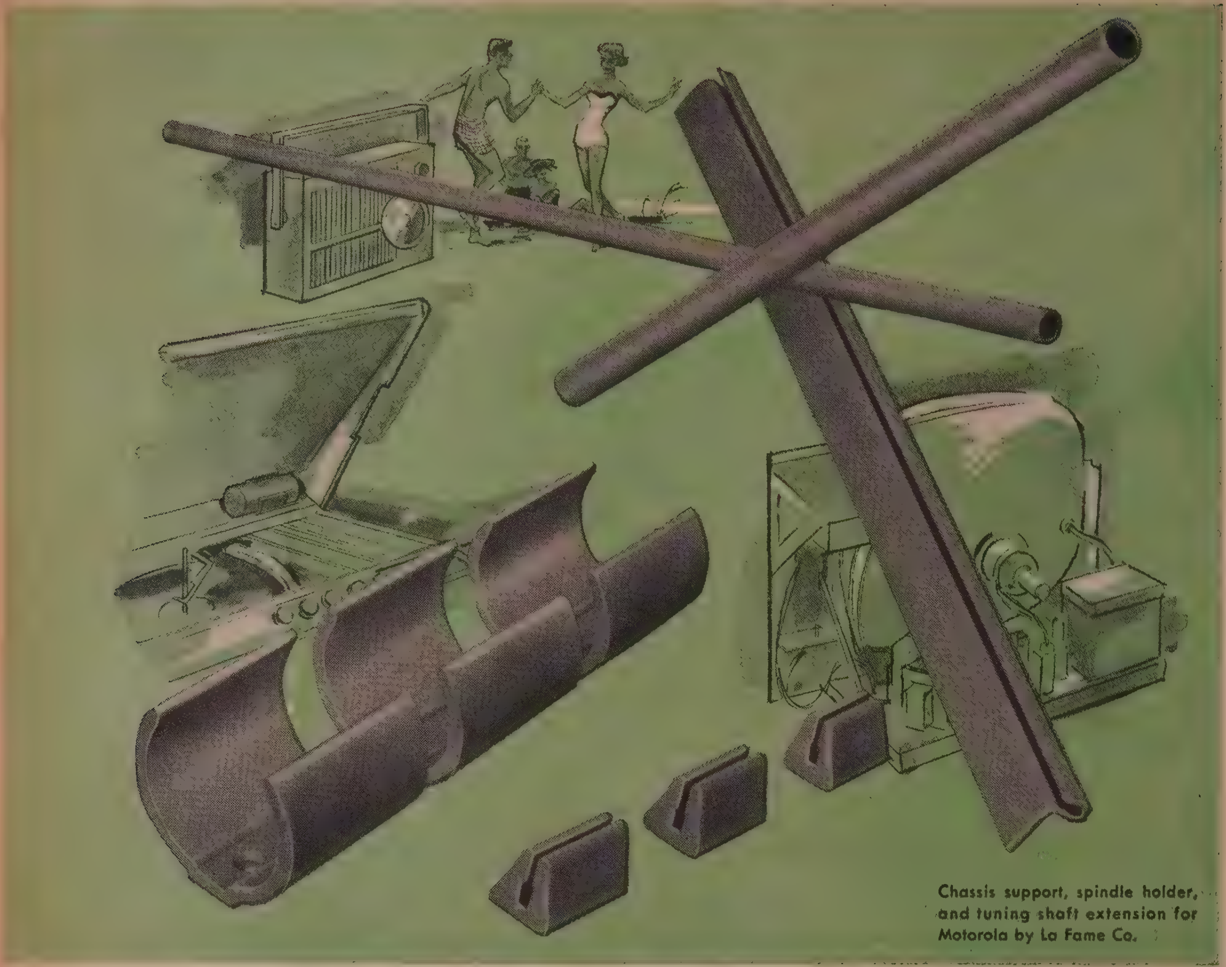
Mr. Olsen's story can be your story, too. You'll find that Honeywell's on-the-spot efficiency gets the job done quickly and correctly . . . by men *specifically* trained for the job. Why not call your local Honeywell office today? Let them tell you about the quality service that has made Honeywell *first in control* since 1885!

75th YEAR PIONEERING THE FUTURE

Honeywell

H HONEYWELL *First in Control*
SINCE 1885

Naugatuck KRALASTIC®



Chassis support, spindle holder, and tuning shaft extension for Motorola by La Fame Co.

EXTRUSIONS

Tougher...stronger...easier with KRALASTIC

The very properties that have made KRALASTIC rubber-resin so outstandingly successful in pipe . . . for oil, gas, water, chemicals and underground electrical conduit . . . offer a host of interesting possibilities for other extrusion products of all kinds. Consider:

KRALASTIC holders for 45 r.p.m. record player spindles have just the springiness required to hold the spindle in place, yet have a tough flexibility that is non-marring to the spindle finish.

Tuning shaft extensions of KRALASTIC provide the torque resistance required, yet are tough enough to prevent accidental breakage. And KRALASTIC's good dimensional stability allows press-fit couplings to both the tuning knob and the tuner itself.

Radio chassis glides of KRALASTIC are not only effective insulators, but are also self-lubricating to ease installation and removal of the chassis from the cabinet.

Investigate the properties of KRALASTIC in relation to your own extrusion products. They could spell product improvement. For full information, write the address below.

United States Rubber
Naugatuck Chemical Division
DEPT. A ELM STREET
NAUGATUCK, CONNECTICUT

KRALASTIC RUBBER-RESINS • **MARVINOL** VINYLS • **VIBRIN** POLYESTERS

Akron · Boston · Chicago · Gastonia · Los Angeles · Memphis · New York · Phila. · CANADA: Naugatuck Chemicals · Elmira, Ont. · Cable: Rubexport, N.Y.

NEW branch circuit WIRE CONNECTOR

IDEAL WING-NUT®

*the **only** one-piece screw-on connector that gives you **all** these benefits . . .*

THE ONLY BUILT-IN WRENCH

Unique wing grip. Twist WING-NUT on quickly, easily, by hand without *any tools.* Easy to splice even largest stiff wires. Simply screw on, then snip off wings for compact spaces. No awkward, slippery, soft-plastic grip. The easiest branch circuit connector you can use!

THE ONLY VISIBLE SPLICE

Your splice is always visible—no take-apart for inspection. WING-NUT is the only screw-on connector that lets you *see* the splice is *right* . . . through the semi-transparent Nylon insulating shell.

JOINS HEAVIEST CIRCUITS

Only WING-NUT has a Nylon shell with such a wide deep skirt to splice even the largest wires. Easily slips over two No. 8 and a No. 6. Easiest connector for thick Type RW, too. No flash-over. Two sizes to handle all your needs.

CAN'T COLD-FLOW WITH NYLON SHELL

Unbreakable, high-dielectric Nylon shell is tough and stable . . . won't cold-flow and short-out by stretching thin under pressure or strain. WING-NUT is the *only* screw-on branch circuit connector giving you the many benefits of the strongest and safest shell . . . genuine Nylon.

THE MOST U.L. BRANCH CIRCUIT COMBINATIONS

UL SA

Both sizes of WING-NUT are Underwriters' Laboratories approved as pressure cable connectors for general use (600V) in branch circuit and fixture wiring. Only WING-NUTS are approved for *474* combinations of solid and/or stranded wire.

WING-NUT is the easiest, fastest, safest branch circuit wire connector you can use. It's inner tension-spring coil actually threads and crushes wires in a shake-proof "PYTHON GRIP!" You just can't make a better splice . . . especially on the new large, hard wires.

IDEAL

The helping hand on every wiring job.

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS

IN CANADA:
IRVING SMITH, LTD.,
MONTREAL

TRY IT YOURSELF • FILL IN AND MAIL THIS COUPON TODAY

IDEAL INDUSTRIES, Inc.
1041-C Park Ave., Sycamore, Illinois

IDEAL

Send me a free WING-NUT sample.

FREE SAMPLE

Name____________________

Company____________________

Address____________________

City__________ Zone____ State________

HATFIELD has

to manufacturing

"have you heard?"

EXPANDED TEST AND DEVELOPMENT FACILITIES

at the new Linden plant are among the most outstanding in the high voltage cable field. In addition to the usually required quality-control test procedures for every foot of cable produced, there are also special tests. For example, we have installed a group of specially designed corona level instruments and test cables — right on the production line. Another "extra" from Hatfield to assure complete customer satisfaction.

MANUFACTURERS OF ALL TYPES OF INSULATED WIRE & CABLE

HATFIELD WIRE & CABLE

he largest new plant devoted exclusively
f rubber covered wire and cable

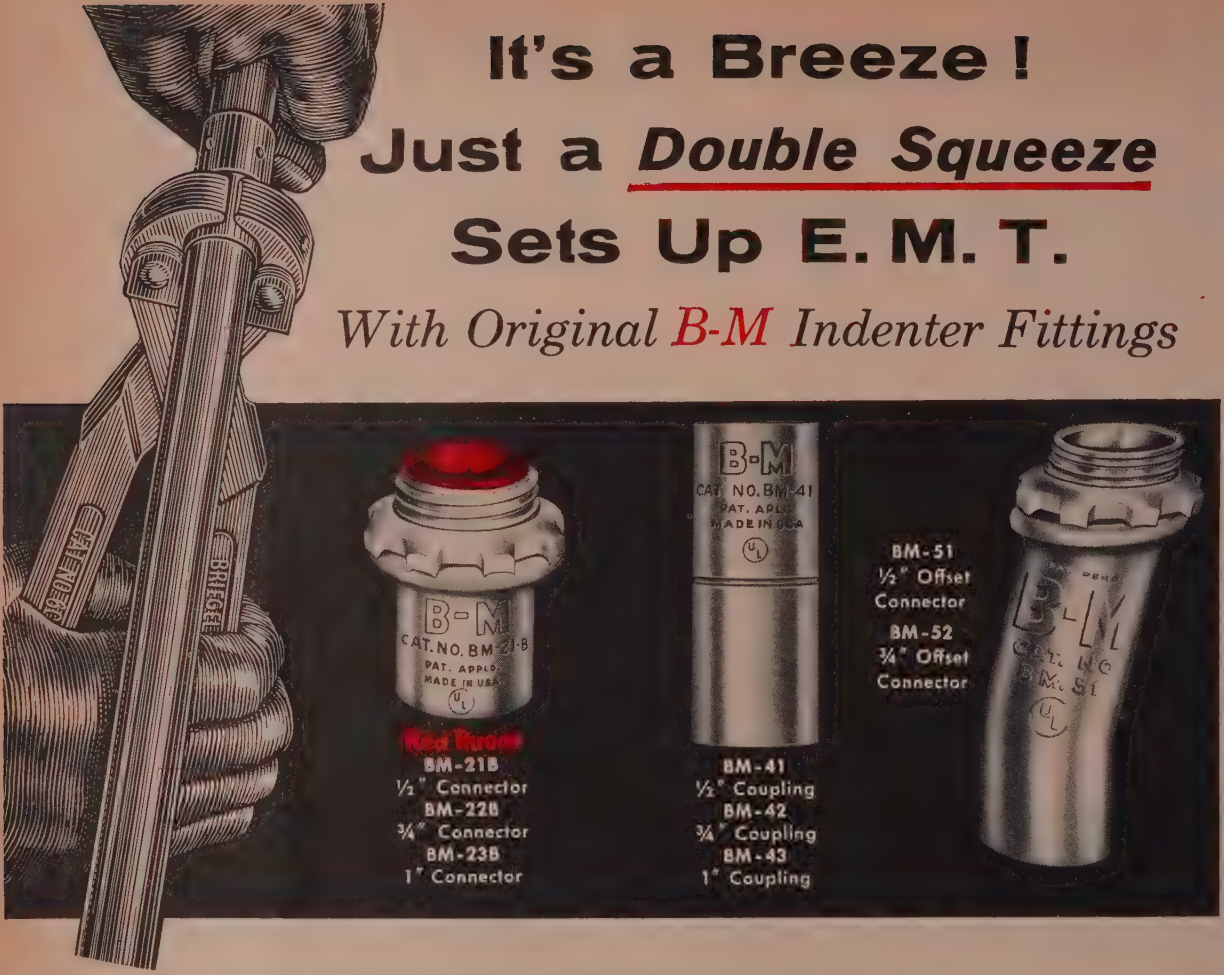
Here's solid proof of Hatfield's confidence in the future of the electrical industry! An entirely new plant, ready to take your orders for rubber insulated high voltage and the larger multi-conductor power cables. We're geared to produce "specials" or to ship standard items from warehouse stock as complete as you'll find anywhere. This new Linden, N. J. plant augments completely separate facilities in Hillside and Union, N. J. where most other types of wire and cable products are manufactured. It all adds up to this—whether your wire and cable needs are for building construction, light or heavy industry, governmental agencies or utilities—now you will find Hatfield to be one of the best equipped producers of the highest quality products.

This new plant for the production of rubber insulated wire and cable, together with the copper rod mill now under construction, will be part of the HATFIELD Linden complex. It is geared to give HATFIELD the most up-to-date, integrated facilities in the wire and cable field.

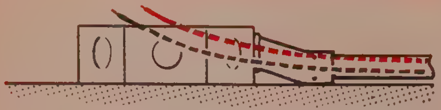
VISION OF CONTINENTAL COPPER & STEEL INDUSTRIES INC. / PLANTS · HILLSIDE · UNION · LINDEN / EXECUTIVE OFFICES · HILLSIDE, NEW JERSEY

It's a Breeze! Just a *Double Squeeze* Sets Up E. M. T.

With Original B-M Indenter Fittings

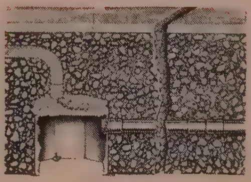


● B-M Indenter Fittings and Tools make an unbeatable combination when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws. Other plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



B-M Offset Connector, showing how wires are guided over box edge.

Briegel All Steel Indenter Fittings are U.L. approved as Concrete-Tight.



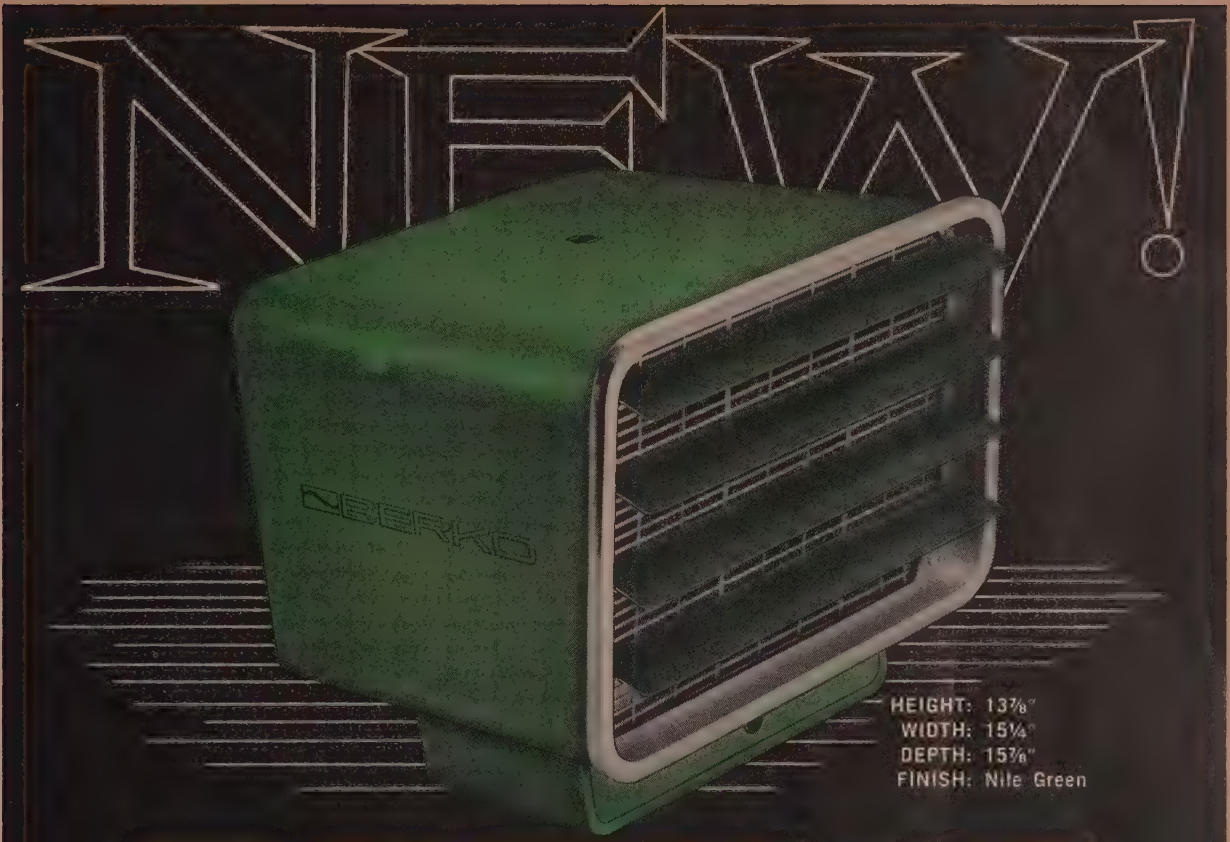
BRIEGEL METHOD TOOL CO.

GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U.L. file card E 10863 and Federal Specifications W-F-406.

TELESCOPE BM SYSTEM

USED THE MOST FROM COAST TO COAST



HEIGHT: 13⅞"
WIDTH: 15¼"
DEPTH: 15⅞"
FINISH: Nile Green

BERKO
ELECTRIC UNIT HEATERS
FOR WALL OR CEILING SUSPENSION

Now! A Unit Heater That Can Be Used Anywhere!

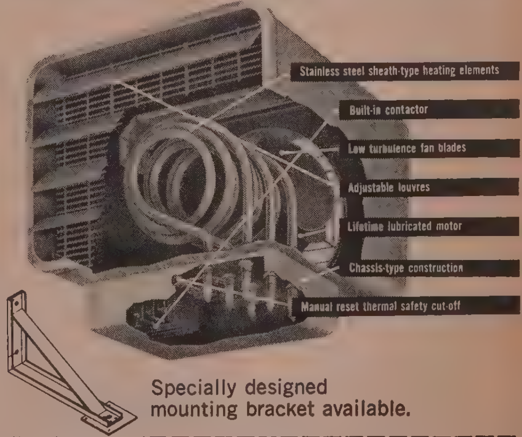
Berko engineers have completely changed the traditional concept of unit heaters with a unit that combines functional excellence and a beauty of design that permits it to blend in easily with *all* types of surroundings — offices, stock rooms, factories, church meeting rooms, stores, work shops . . . anywhere dependable heat is needed! Available in 5 or 7½ KW capacities (208, 240 and 480 volts), the new Berko Unit Heater features:

- ⅝" heavy duty stainless steel, totally enclosed non-glowing sheath-type heating elements warranteed for 5 years.
- Heavy duty built-in contactor which eliminates the need for costly external contactors and additional wiring.
- Manual reset thermal safety cut-off provides positive protection against overheating.
- Each heater may be hooked up either single or three phase.
- Pivotal mounting enables entire body of unit to be turned in any direction.
- Chassis-type construction permits entire internal unit to be easily removed for cleaning and servicing.

For further information and full specifications on this dramatic, new engineering achievement, mail this coupon today.

BERKO ELECTRIC MANUFACTURING CORPORATION
First in glass electric radiant and convection heating equipment
212-40 JAMAICA AVENUE, QUEENS VILLAGE 28, N. Y.

Check These Features of BERKO'S New Unit Heaters


Stainless steel sheath-type heating elements
Built-in contactor
Low turbulence fan blades
Adjustable louvres
Lifetime lubricated motor
Chassis-type construction
Manual reset thermal safety cut-off

Specially designed mounting bracket available.

Berko Electric Manufacturing Corp., Dept. M-3
212-40 Jamaica Avenue, Queens Village 28, N. Y.

☐ *Please send full information on Berko's new Unit Heaters.*

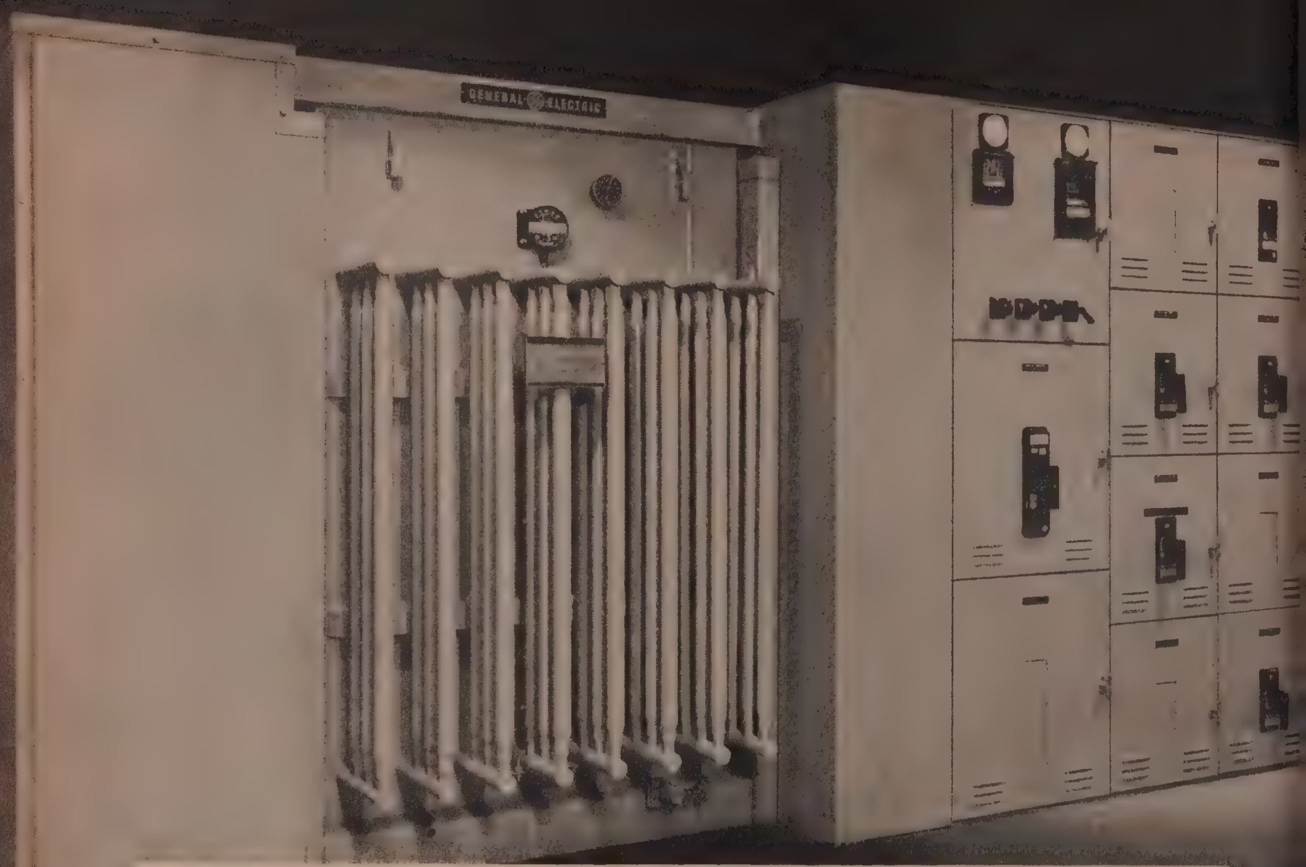
☐ *Send full line catalog.*

Name ____________________

Company ____________________

Address ____________________

City __________ Zone ____ State ______



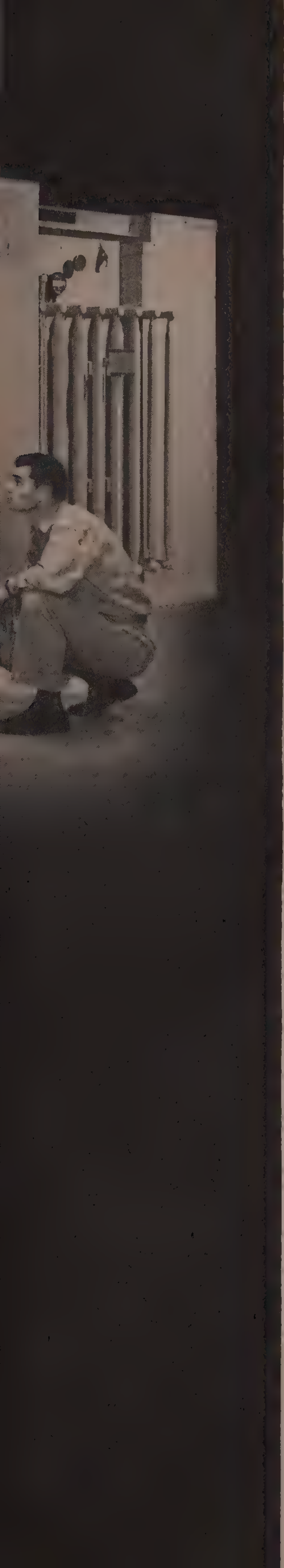
Selectively Coordinated **load centers give maximum service continuity . . . and now cost you less**

1. **SAVE UP TO $600 PER BREAKER** because General Electric has eliminated the price premium for selective trips when supplied with G-E switchgear equipments.

2. **SAVE UP TO $630 PER BREAKER** by using manually operated, stored-energy breakers in place of electrical units formerly required.

Total savings vary from $465 to $930 per breaker, depending on size.

How much can you save? Ask your General Electric sales engineer.



General Electric *Selectively Coordinated*

Load Center Unit Substations now are . . .

Yours at Lower Cost

YOU NOW PAY LESS

You can purchase G-E *Selectively Coordinated* load center unit substations at new low prices. General Electric has eliminated the price premium normally charged for this inherently higher-cost, more highly-engineered product. This means that you can now get superior service for the same price as the more common, but less "intelligent," fully-rated load center unit substation. Further savings can be realized by the use of manually operated stored-energy breakers.

SELECTIVELY COORDINATED LOAD CENTERS MINIMIZE DOWNTIME

In the *Selectively Coordinated* load center, the tripping times of the main and feeder breakers are coordinated so that during short-circuit conditions, power is removed only from the faulted feeder. Power continues to flow to the unfaulted feeders—thus preventing costly, unnecessary downtime. (See diagram below.)

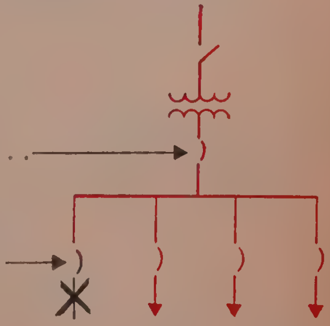
SIMPLY SPECIFY SELECTIVE COORDINATION

Order the *Selectively Coordinated* load center. Upon delivery, you will receive time-coordination curves which show you the factory-preset characteristics of each breaker, how they combine to assure you of the best possible service continuity.

For more detailed information, contact your nearest G-E Apparatus Sales Office or write to General Electric Co., Schenectady 5, N. Y. for bulletin GEA-3592. 531-01

HOW *Selective Coordination* PREVENTS UNNECESSARY DOWNTIME

WITH G-E SELECTIVELY COORDINATED load center unit substations, feeder breakers are adjusted to clear any magnitude of feeder fault. The selective main breaker preserves power continuity to unfaulted feeders.



This main Breaker WAITS . . .

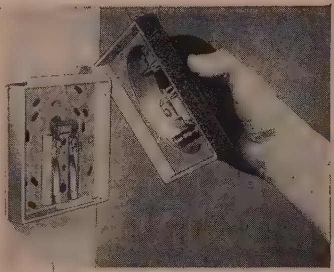
. . . . UNTIL this breaker clears the feeder fault.

Progress Is Our Most Important Product

GENERAL ELECTRIC

"We Hooked it Up and Walked Away"

In the electrical signaling and communication industry this expression, coming from an electrical contractor, is the highest recommendation he can give of a manufacturer's equipment. It means "Well done! Your system installed easily and worked properly the first time. No rejects . . . no grounds or shorts . . . no trouble shooting, with all that means in running up the cost of a job. It worked like a charm!"



We're accustomed to hearing this expression quite frequently at Auth. Our equipment has always been designed to make installation easy. We give the contractor what he needs . . . wiring diagrams, equipment drawings, installation and operating instructions. All material is thoroughly tested before shipment.

Auth
SINCE 1892

We . . . at Auth . . . do this not only because it comes naturally. We do it because every time a contractor says to us "We hooked it up and walked away," we know that he'll be coming back to us on the next job. That's good will.

Manufacturers of
ELECTRICAL SIGNALING,
TIME AND COMMUNICATION
SYSTEMS FOR HOSPITALS,
SCHOOLS, HOUSING,
INDUSTRY AND SHIPS

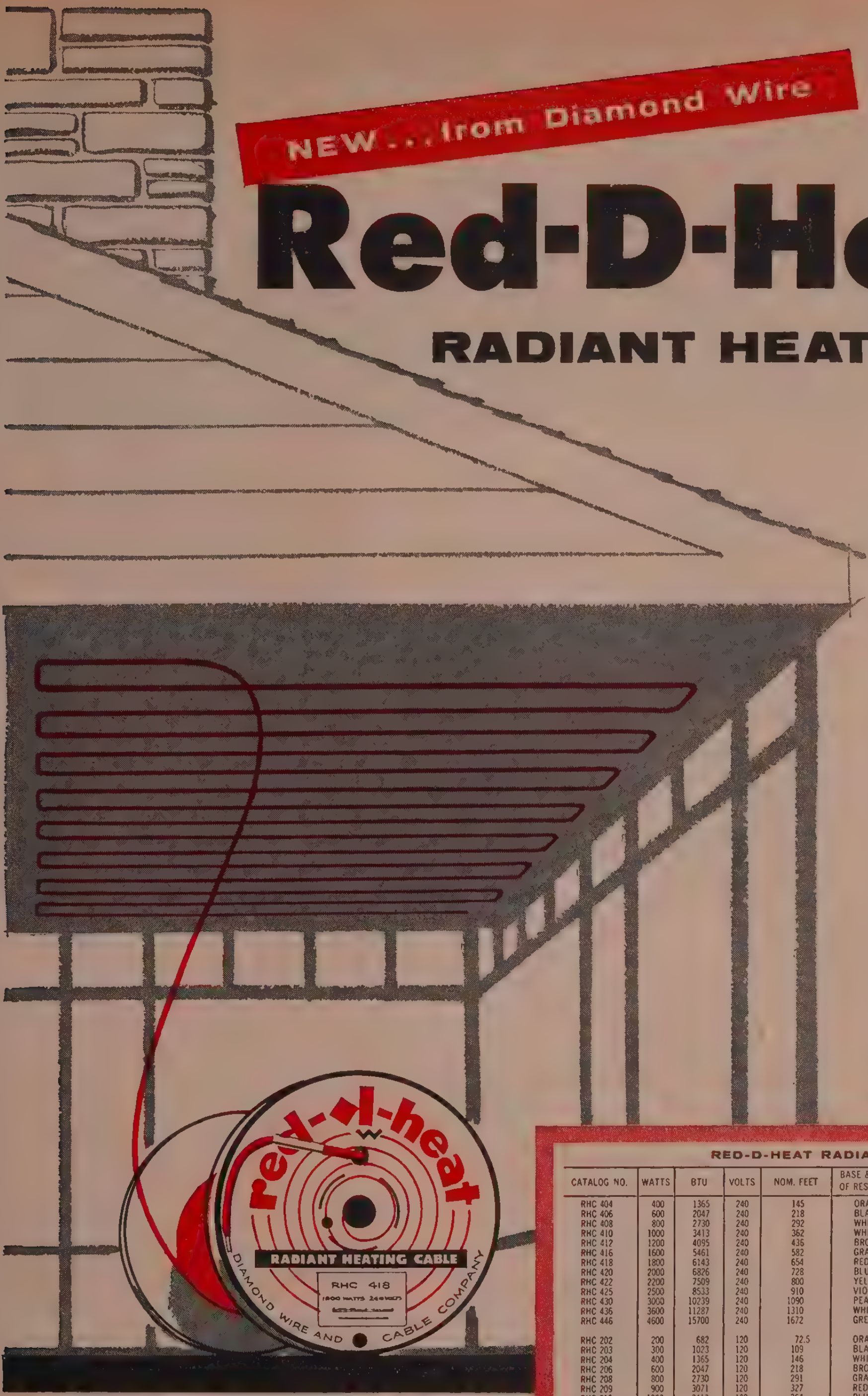
Sold in cooperation with the distributor

Auth Electric Company, Inc.
LONG ISLAND CITY 1, NEW YORK

NEW . . . from Diamond Wire

Red-D-Heat®

RADIANT HEATING CABLE



Now . . . an important addition to a dependable line of wire and cable, *Red-D-Heat* joins the family of quality products that have already established Diamond as a respected and accepted supplier to the construction field. Red-D-Heat is available in a full line of nylon and thermoplastic insulated radiant heating wire . . . manufactured under strict quality control to deliver "full capacity."

Each unit of Red-D-Heat is packaged on non-returnable metal reels in a definite length to supply a specific wattage at standard voltage rating. Every unit is equipped with an 8-foot firmly spliced non-heating nylon lead, and all wire is color coded and tagged to identify wattage and voltage.

RED-D-HEAT RADIANT HEATING CABLES

CATALOG NO.	WATTS	BTU	VOLTS	NOM. FEET	BASE & PRINT COLOR OF RESISTANCE WIRE	NON HEATING LEADS— 8 FT TW—NYLON JACKET	CABLES PER CARTON	SHIPPING WEIGHT PER CARTON
RHC 404	400	1365	240	145	ORANGE (BLK)	Red #14	8	11
RHC 406	600	2047	240	218	BLACK (WHI)	Red #14	6	14
RHC 408	800	2730	240	292	WHITE (BLK)	Red #14	6	17
RHC 410	1000	3413	240	362	WHITE (RED)	Red #14	6	20
RHC 412	1200	4095	240	436	BROWN (BLK)	Red #14	6	20
RHC 416	1600	5461	240	582	GRAY (BLK)	Red #14	6	26
RHC 418	1800	6143	240	654	RED (BLK)	Red #14	6	29
RHC 420	2000	6826	240	728	BLUE (BLK)	Red #14	6	32
RHC 422	2200	7509	240	800	YELLOW (BLK)	Red #14	6	35
RHC 425	2500	8533	240	910	VIOLET (BLK)	Red #14	6	47
RHC 430	3000	10239	240	1090	PEACH (BLK)	Red #14	6	47
RHC 436	3600	11287	240	1310	WHITE (BLU)	Red #12	6	65
RHC 446	4600	15700	240	1672	GREEN (BLK)	Red #12	6	104
RHC 202	200	682	120	72.5	ORANGE (BLK)	Yellow #14	6	4.5
RHC 203	300	1023	120	109	BLACK (WHI)	Yellow #14	6	8
RHC 204	400	1365	120	146	WHITE (BLK)	Yellow #14	6	11
RHC 206	600	2047	120	218	BROWN (BLK)	Yellow #14	6	11
RHC 208	800	2730	120	291	GRAY (BLK)	Yellow #14	6	11
RHC 209	900	3071	120	327	RED (BLK)	Yellow #14	6	14
RHC 210	1000	3413	120	364	BLUE (BLK)	Yellow #14	6	17
RHC 211	1100	3754	120	400	YELLOW (BLK)	Yellow #14	6	17
RHC 212½	1250	4266	120	455	VIOLET (BLK)	Yellow #14	6	17
RHC 215	1500	5122	120	545	PEACH (BLK)	Yellow #14	6	23

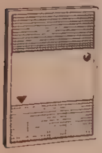
Write today for information describing the complete Red-D-Heat line.

Trade Mark ®

DIAMOND
WIRE and **CABLE** Company
Sycamore, Illinois
WAREHOUSES: Pittsburgh • Cleveland • Minneapolis • Denver • Dallas • Atlanta

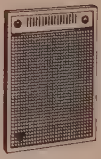
MAKE GRAYBAR YOUR

Space Heating



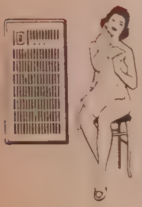
Wall Convectors with Natural Ion-Balance

These units circulate warmed air electrically cleaned of airborne bacteria, pollen, mold spores. Ideal where furniture must be placed nearby.



Forced Air Heaters

Handsome, compact units for kitchen, laundry, game room, and commercial applications. Circuitry provides for independent operation of fan and heat.

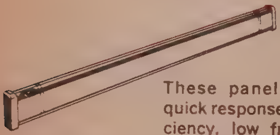


Bathroom Heaters

Here are heaters that eliminate mildew, dampness, foggy mirrors; that provide radiant heat; that fit smallest to largest bathrooms.

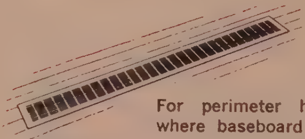
Radiant Heaters

These offer a healthful balance of warm-air circulation and the penetrating warmth of infra-red heat, plus modern ion-control.



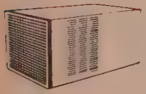
Baseboard Panels

These panels feature quick response, high efficiency, low front panel temperature. Module construction permits tailoring to customer preference.



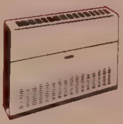
Perimeter Convectors

For perimeter heating where baseboard application is not practical. To clean, owner merely lifts out grille. Easy to install.



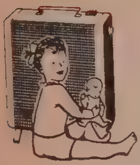
Heat Pumps

The heat pump, in one self-contained unit, provides both heating and cooling. 3 and 5-ton remote or self-contained tuckaway models, for residential or commercial application.



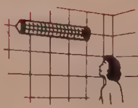
Electric Cabinet Heaters

Designed for heavy heat load; available for floor, wall or ceiling; recessed or open. Variable heat and summer-winter fan switches. Thermostat. Permanent or renewable filters.



Portable Heaters

Air purifying features of these heaters give them special appeal to a large section of the market. Push-button control, thermostat, quiet dependability.



Infra-Red Radiant Heaters

Handsome chrome trim frame. A "decor" asset to any modern game room or laundry room. Quartz splash-proof tube. Safety design.

Electric space heating is on the way . . . for homes . . . stores . . . offices . . . schools . . . industrials . . . and many other applications.

These important points are worth underlining. Electric heating is clean, free of odor, quiet, healthful, efficient, adaptable and dependable. In comparison to the climbing costs of other forms of heating, electric heating steadily becomes more economical.

To realize the most from this growing field you'll be wise to pinpoint here and now the one best source for electric space heating equipment.

In combined range of equipment offered, knowledge of equipment capability, and practical problem-solving know-how, Graybar is your standout. And always, the Graybar Field Salesmen, Inside Salesmen, Specialists and Countermen work as a team to see that your requirements are clearly understood and precisely met . . . promptly.

Now, plan to make Graybar your Headquarters for electric space heating equipment. Call or write your nearest Graybar office or stop in . . . for complete, up-to-the-minute information on any of the equipment you see here. We'll welcome your inquiry.

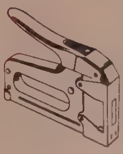
GRAYBAR ELECTRIC COMPANY, INC. • 420 LEXINGTON AVE.

Headquarters

FOR ALL YOUR ELECTRICAL EQUIPMENT NEEDS

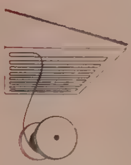
Ceiling Heaters

Infra-red, radiant and convectional heaters. All with illumination. Some with circulator or exhaust fan. For new construction or remodel work.



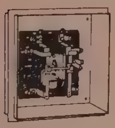
Staple Gun for Radiant Heating Cable

Specially designed to install heating cable without damage to insulation. Underwriter approved when used with Red-D-Heat cable.



Radiant Heating Cable

Nylon and thermoplastic insulated radiant heating wire. Non-heating power leads. Quality materials and manufacture to assure longlife heating service.

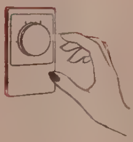


Centramatic Control

A packaged kit that adds to owner comfort and system efficiency. Master control gives you central control of each zone in your system.

Home Weather Station

Gives room by room control from a central location. Indicates temperatures, humidity, barometric pressure. Clock provides for automatic temperature setback and pickup.

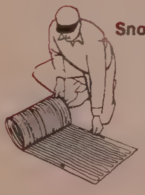


Thermostats

Thermostats for all control needs of electric heating. For residential use, line voltage units, low voltage units with transformers, low and normal temperature range units.

Remote Control for System Heating

Eliminates overheating and underheating. Saves costs of heating unoccupied units, regulates all units remotely. Of special interest to motel owners.



Snow and Ice Melting Heater

Electric heat roll-out units, 10 feet by 18 inches, are easily imbedded in concrete when building driveway or steps. Owner then can melt snow and ice "at a flip of the switch."

Electric Anti-Freeze Units

Moistureproof, vinyl protected, wrap-around heat bands that protect pipes and gutters from ice damage.

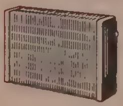
Bracket-Type Industrial Convectors

For hazardous locations with ether vapor or similar gases; or with gasoline vapor or gases of comparable ignition temperatures. Available with built-in manual reset cutout. 2- or 3-heat switch.

Infra-Red Radiant Industrial Heater

Of widening use to heat, dry and cure products in process; to keep workers warm in large areas at extremely low cost. Thermal shock won't crack tube. Rugged. Safe.

Electric Unit Heaters for Office, Store or Industrial Use



Black heat type, 1½ to 7½ kw heaters designed for years of trouble-free service. Super-quiet fan. Enclosed motor. Bracket for wall or ceiling mounting.

GraybaR

call **GraybaR** *first for*

GraybaR Everything Electrical
QUALITY
SINCE 1869
REG U.S. PAT OFF
GraybaR ELECTRIC COMPANY

949

NEW YORK 17, N. Y. • IN OVER 130 PRINCIPAL CITIES

CRESCENT

ABC

ARMORED CABLE TYPE ACT

With Improved Features

- EASIER
- QUICKER
- SAFER

PLASTIC INSULATED CONDUCTORS

are clean, easy stripping, with solid, clear colors, and minimum diameter for easier installation in boxes.

PAPER TAPE

which is tough, moisture-resistant yet easily removed, gives protection to the insulated conductors.

INSULATED BUSHING

for protection against sharp ends of armor, furnished with each coil of cable.

BOND STRIP UNDER ARMOR

is used in all sizes. A flattened aluminum bonding wire in contact with the under side of each convolution of the galvanized steel armor assures a permanent, low resistance through armor to ground.

PREFABRICATED BREAKING LINES

At intervals of every 1½ inches on CRESCENT ABC Armored Cable you will find a small cut mark. This cut mark shows the location of a prefabricated breaking line inside the armor.

ONLY a few short strokes of a hacksaw guided by the cut mark are required to cut through ONE outer ridge, and a bend by hand severs the armor. By actual test, this saves 30% of the time ordinarily required. A clean separation results, with no sharp edge. There is no chance of injury to insulation because only one OUTER ridge is cut.

THE prefabricated breaking lines in the armor are so made that THERE IS NO REDUCTION of tensile strength, bending qualities, crushing resistance or electrical conductivity. This armor construction meets all requirements of Underwriters' Laboratories.

CRESCENT INSULATED WIRE & CABLE CO., INC.

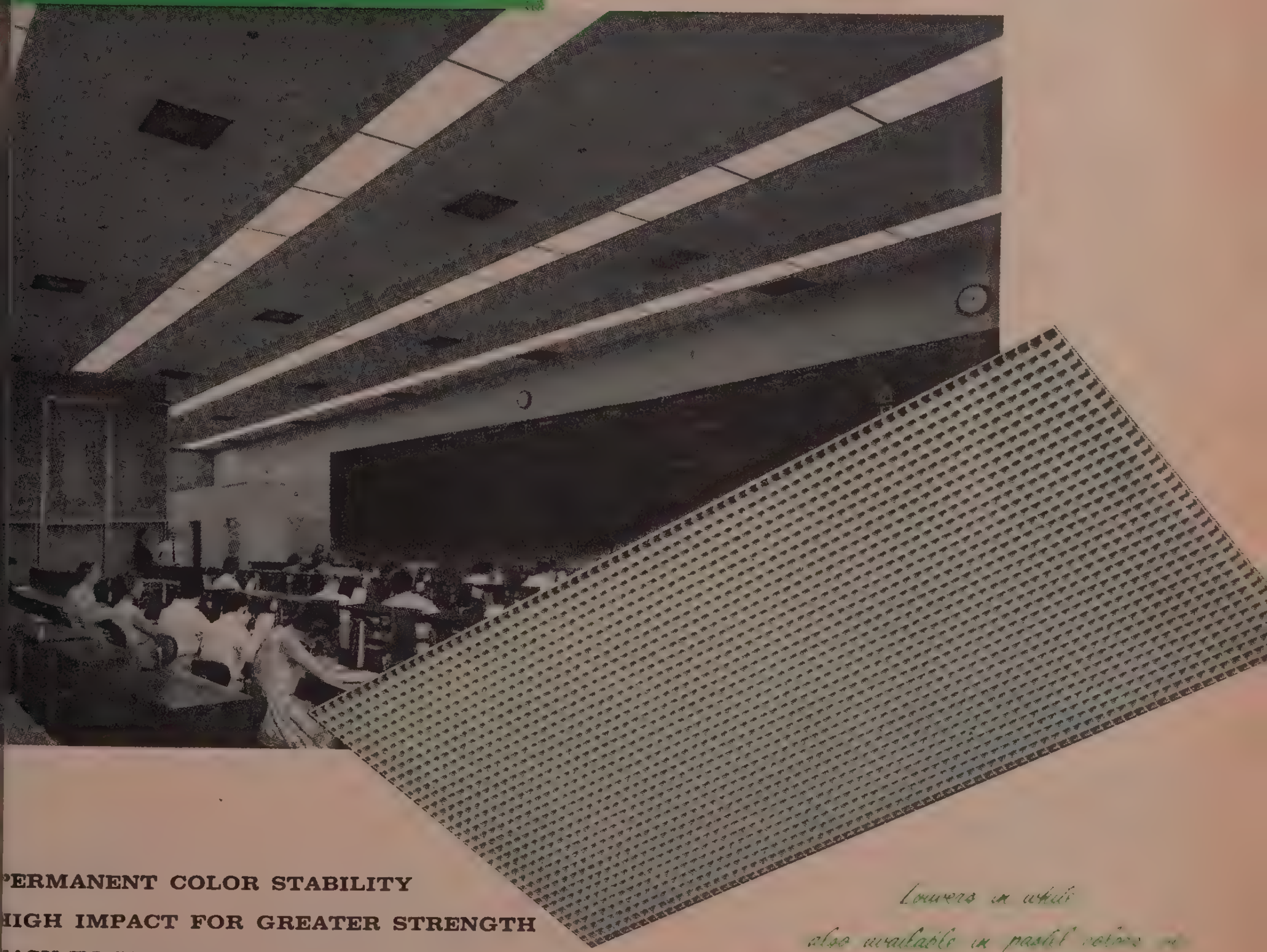
TRENTON, NEW JERSEY

OVER 75 YEARS EXPERIENCE

American louvers exclusive design
nd construction provide highly ef-
icient lighting levels without glare
—they conform to or exceed the stand-
rd recommendations for proper
ight shielding. Leading architects
nd consulting engineers specify and
se American plastic louvers due to
heir versatility and easy adaptability
o most lighting installations.

eastern air lines feature american plastic louvers—

for perfect shielding with unexcelled seeing comfort and efficiency required for todays high-speed service......



Louvers in white
also available in pastel colors of
blue, pink, green, yellow and lime [illegible]

ERMANENT COLOR STABILITY

IGH IMPACT FOR GREATER STRENGTH

ASY TO HANDLE—LIGHT WEIGHT

/8" CELLS 45° x 45° LIGHT CUTOFF
FOR GREATER LIGHT TRANSMISSION

ATENTED INTERLOCKING LOUVERS
SSURE PERFECT ALIGNMENT

OW COST UPKEEP—EASY TO CLEAN

AVAILABLE IN COMBINATION OF SIZES

OUVERS MAY BE CUT TO SPECIFICATIONS

Engineers are available in your area to help with your lighting problems or write American Louver Company direct.

american louver company

[illegible] AVENUE [illegible]

xclusive process by American Louver Company
.S.A. Patent No. 2,566,817   U.S.A. Patent No. 2,607,455
Canadian No. 484,346   Canadian No. 497,047

LIKE to generate a bigger share of new electrical contracts? Have a feeling you're missing good opportunities to bid? Like to uncover more jobs that are "tailor-made" for you...when and where you want them? You need daily Dodge Reports !!

DODGE REPORTS are individual building project reports. They're mailed to you daily. You get REPORTS on just the types of building you're interested in—in the area where you do business. They tell who's going to build what and where . . . whom to see . . . when bids are wanted . . . who else is bidding . . . who gets which awards.

When you use DODGE REPORTS, you always know what's coming up. You don't depend only on invitations to bid. You concentrate on jobs you *know* will be profitable.

If you do business anywhere in the 37 Eastern states, you need DODGE REPORTS.

SEND FOR THIS FREE BOOK

F. W. Dodge Corporation, Construction News Division
119 West 40th Street, New York 18, N. Y., Dept. ECM30

Send me the book: "How Subcontractors Get More Work in New Construction" and let me see some typical Dodge Reports for my area. I am interested in the general markets checked below.

☐ House Construction ☐ General Building
☐ Engineering Projects (Heavy Construction)

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Name____________________
Company____________________
Address____________________
City__________ Zone______ State________

F. W. DODGE CORPORATION

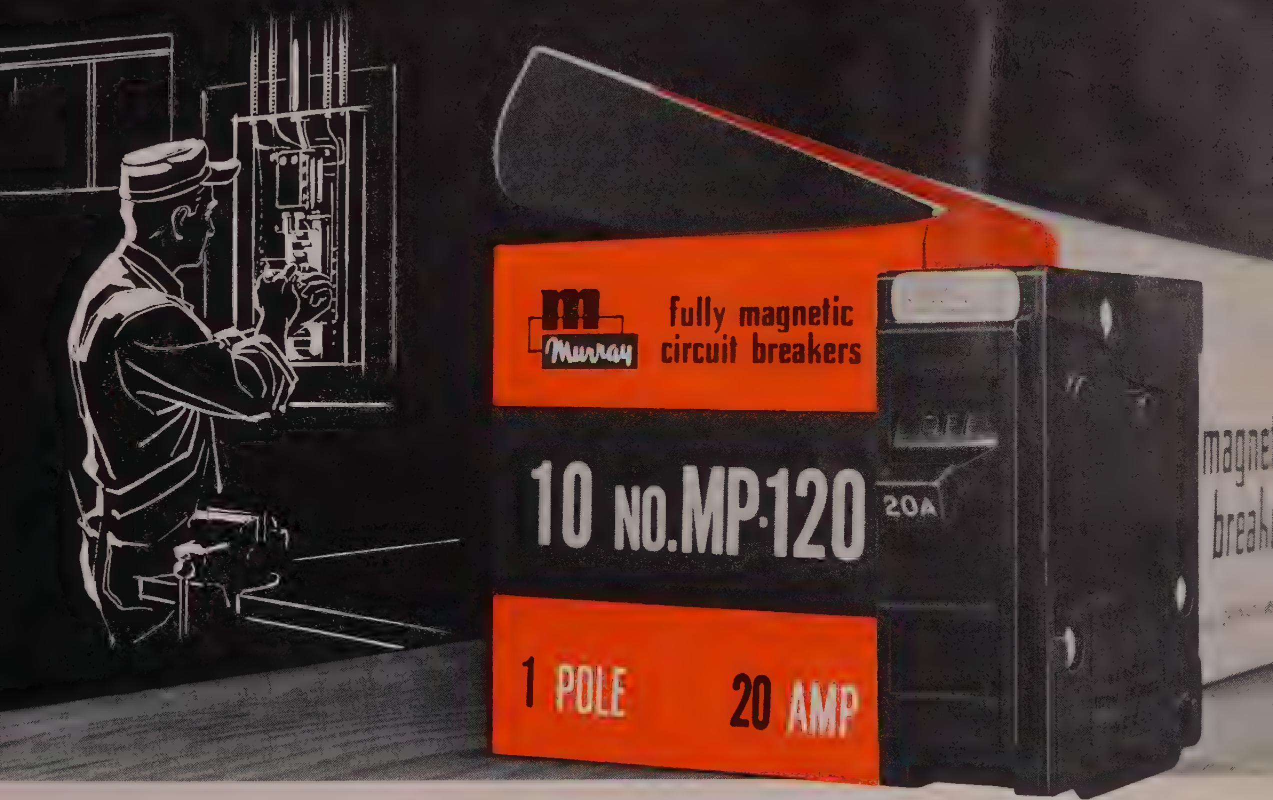
Dodge Reports

HELP
ELECTRICAL CONTRACTORS
GET MORE BUSINESS

- FULLY MAGNETIC
- PLUG-IN TYPE
- COMPETITIVELY PRICED . . . *AND NOW*

GUARANTEED FOR LIFE

Murray "MP" Circuit Breakers



because only the best offers

fully magnetic circuit breaker protection

60TH YEAR
Murray

carries full rated load • no derating • unaffected by heat
installs anywhere • protects against flash shorts • no nuisance tripping
superior branch circuit protection • ends callbacks

Best Breaker in Biggest Promotion Yet: GUARANTEED

...against defective materials or workmanship

BEST FOR HOMEOWNERS

Full "MP" 6-Point Circuit Protection

Always Carries Full Rated Load – "MP" breakers are unaffected by heat, can be installed anywhere, carry full-rated load at all times.

Never Trips Unnecessarily – temporary overloads or in-rush loads of additional appliances will not cause "MP" breakers to trip unnecessarily.

Gives Superior Branch Circuit Protection – assures protection against flash shorts.

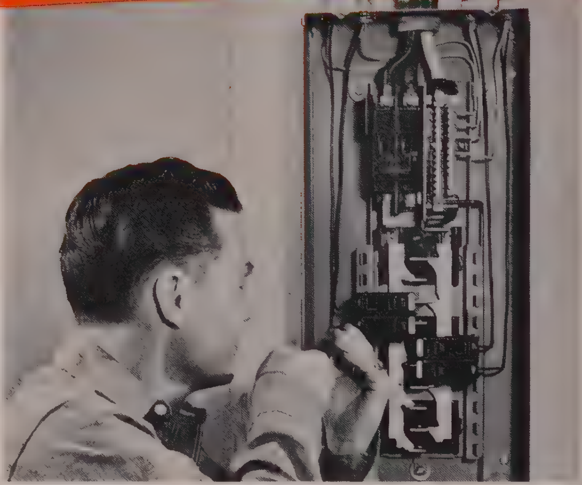
Acts Instantly On Short Circuits – trips instantaneously on short circuits.

Resets Immediately, No Waiting – "MP" breakers need no cooling period to reset yet can't be closed while dangerous overload continues.

Only 2 Handle Positions – no guessing whether breaker is on or off.

MODERN CONVENIENCE AND SAFETY THAT'S . . . GUARANTEED FOR LIFE . . . ASSURANCE OF THE HIGHEST QUALITY PROTECTION

BEST FOR CONTRACTORS



Fast Installation — No Callbacks

Installs Anywhere – Unaffected by heat, "MP" breakers can be installed near furnace, kitchen range or heating outlet – wherever it's best for shortest wiring runs and maximum convenience.

Rigid Plug-In – Practical design allows "MP" breakers to be plugged in with minimum of effort and stay put for positive electrical contact.

Eliminates Callbacks – nuisance tripping no longer a problem; callbacks are eliminated to give you maximum profits per job.

Customer Satisfaction – satisfied customers call *you* for their next electrical job, recommend you to friends and neighbors, help build your reputation for providing the finest in circuit protection.

SUPERIOR CIRCUIT PROTECTION THAT'S . . . GUARANTEED FOR LIFE . . . A SELLING POINT THAT INSTILLS CONFIDENCE IN THE WHOLE WIRING JOB

PLUS...THESE MONEY-MAKING SALES AIDS...

to help you sell the safety of fully magnetic "MP" protection and the security of a lifetime guarantee –

1. Helpful consumer booklet aims at getting rewiring business; sells full Housepower and "MP" *Guaranteed For Life* Protection through your services.

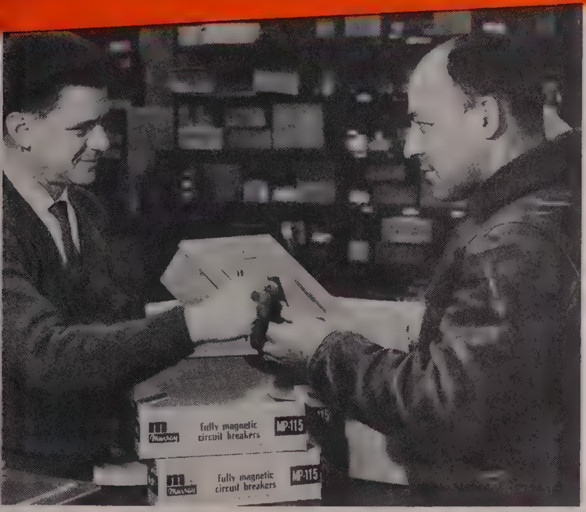
2. *Guaranteed For Life* sticker on each Murray Load Center you install is designed to take your company name. Serves as reminder to homeowners and neighbors that *yours* is the firm to call for satisfactory electrical service.

3. *Guaranteed For Life* Warranty which you give homeowner on completion of job assures her that you have provided the best possible circuit protection.

FOR LIFE

during life of original installation

BEST FOR DISTRIBUTORS



Satisfied Contractors — No Returns

Contractor Satisfaction – "MP" breakers always carry full rated load – require no time-consuming derating. Ease of installation helps contractors save additional time on the job.

No Complaints – fully magnetic operation eliminates call-backs, greatest source of contractor dissatisfaction.

Competitively Priced – you handle the line that gives contractors' customers the finest circuit protection possible at competitive prices.

Full Line Of Breakers – "MP" breakers are available in these ratings: single and two pole, 15 to 50 ampere, 120/240 Volts A.C.

Full Line Of Load Centers – from 2 to 42 circuits, indoor or raintight construction and all with Murray easy-to-wire features.

FAST MOVING LINE THAT'S . . . GUARANTEED FOR LIFE . . . PROOF YOU'RE SELLING THE FINEST

4. Monthly advertising to builders in the pages of The American Builder sells the sales advantages of *Guaranteed For Life* "MP" breakers – helps you get more business.

5. Two color, four page folder for builder-architect files points up sales promotional aids available like: model home signs, salesmen's fact sheet, mobiles, guarantee certificates, load center stickers, etc.

See last page on how you can take advantage of the Murray "MP" *Guaranteed For Life* Promotion.

Backed by a Full Line of Load Centers

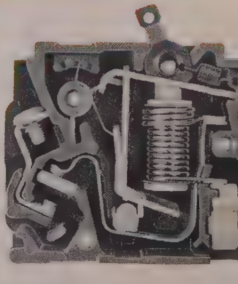
. . . with features that make wiring easier, faster, more economical

- neutrals on top near main
- U.L. approved connectors for copper and aluminum wire
- Flush mounting adjustments
- Shallow box construction
- Sequence bussing for 2 and 3 pole circuits
- Plenty of knockouts, generous wiring room

Circuit breakers and load centers will conform to non-interchangeability requirements of Para. 240-25 of 1959 N.E.C. effective July 1, 1960.

Main Lugs	Single and 3 phase, 2 to 42 circuits, 40 to 200 amps, indoor and raintight
Split Bus	14 to 42 circuits, 125 to 200 amps, indoor and raintight, double mains
Main Breaker Disconnect	12 to 40 circuits, 100 to 200 amps, indoor and raintight

HERE'S *WHY* "MP" *GUARANTEED FOR LIFE* BREAKERS ARE BEST



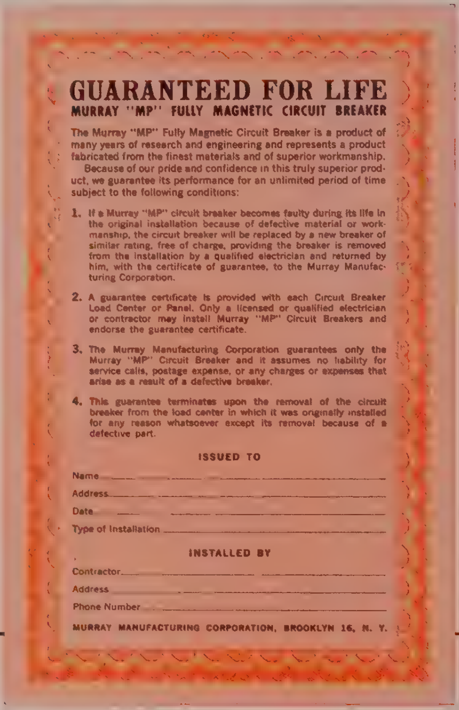
HOW THE "MP" BREAKER WORKS

Reason for the complete circuit protection provided by t "MP" breaker lies in the fully magnetic "iron core". Break is designed to operate on current only – not heat – thus c provide complete protection at *all* degrees of overloa

Here's how you can cash in on this GUARANTEED FOR LIFE *Program*

Contractors:

1. See your Murray distributor first thing. Get your supply of "MP" promotional material. Use them – they'll help you sell. If he's out of them . . . write directly to Murray.
2. Mail consumer homeowner booklet to all your rewiring prospects – establish yourself as *the* contractor with the *Guaranteed For Life* breaker.
3. Give your customers the *Guaranteed For Life* warranty when you complete a job – it'll strengthen your reputation.
4. Put the *Guaranteed For Life* sticker with your name on all new load centers containing "MP" circuit breakers – builds customer satisfaction, leads to new business. You'll find *Guaranteed For Life* stickers and warranties in all new load centers.
5. Mail four page builder folder to your entire builder list. Builders will go for the extra sales clincher of *Guaranteed For Life* "MP" breakers. You can get all the materials you need from Murray.
6. Always use fully magnetic "MP" circuit breakers . . . they're *GUARANTEED FOR LIFE!*



GUARANTEED FOR LIFE

MURRAY "MP" FULLY MAGNETIC CIRCUIT BREAKER

The Murray "MP" Fully Magnetic Circuit Breaker is a product of many years of research and engineering and represents a product fabricated from the finest materials and of superior workmanship.

Because of our pride and confidence in this truly superior product, we guarantee its performance for an unlimited period of time subject to the following conditions:

1. If a Murray "MP" circuit breaker becomes faulty during its life in the original installation because of defective material or workmanship, the circuit breaker will be replaced by a new breaker of similar rating, free of charge, providing the breaker is removed from the installation by a qualified electrician and returned by him, with the certificate of guarantee, to the Murray Manufacturing Corporation.
2. A guarantee certificate is provided with each Circuit Breaker Load Center or Panel. Only a licensed or qualified electrician or contractor may install Murray "MP" Circuit Breakers and endorse the guarantee certificate.
3. The Murray Manufacturing Corporation guarantees only the Murray "MP" Circuit Breaker and it assumes no liability for service calls, postage expense, or any charges or expenses that arise as a result of a defective breaker.
4. This guarantee terminates upon the removal of the circuit breaker from the load center in which it was originally installed for any reason whatsoever except its removal because of a defective part.

ISSUED TO

Name ____________________

Address ____________________

Date ____________________

Type of Installation ____________________

INSTALLED BY

Contractor ____________________

Address ____________________

Phone Number ____________________

MURRAY MANUFACTURING CORPORATION, BROOKLYN 16, N. Y.

Distributors:

1. Get the full story from your Murray representative. He'll supply you with all the promotional materials you need: mobiles, window streamers, wall charts, countergiveaways, etc.
2. Put up display items – takes just a minute. Let your customers know you're headquarters for *Guaranteed For Life* "MP" breakers.
3. Check your stocks of "MP" breakers and load centers. If they're below top levels – order now!

60 TH YEAR

Murray

Murray Manufacturing Corp.
1250 Atlantic Avenue
Brooklyn 16, N. Y.

Murray Manufacturing Corp., 1250 Atlantic Avenue, Brooklyn 16, N. Y.

Gentlemen: A circuit breaker that's *Guaranteed For Life!* I'm interested. As soon as possible, send me complete information on everything.

Name..

Address..

Type of business..

My wholesaler is..

new 1960 RLM Specifications Book

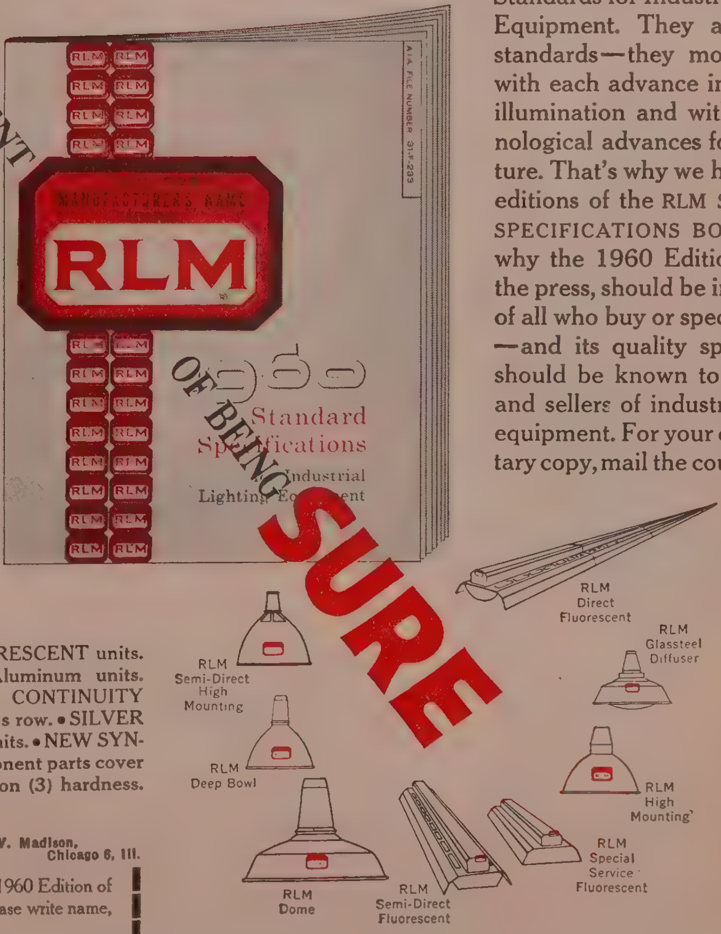
Brings you New and Upward Revised Standards

BUT

...remember this important fact, this new Edition Announcement emphasizes that RLM Specifications for industrial lighting units are not fixed Standards. They are Quality Standards that advance with the Industry and the Science of Illumination.

RLM Standards are Product Quality and Lighting Quality Standards for Industrial Lighting Equipment. They are moving standards—they move upward with each advance in the art of illumination and with the technological advances for manufacture. That's why we have annual editions of the RLM STANDARDS SPECIFICATIONS BOOK. That's why the 1960 Edition, now off the press, should be in the hands of all who buy or specify lighting—and its quality specifications should be known to all makers and sellers of industrial lighting equipment. For your complimentary copy, mail the coupon today.

THE FINAL INGREDIENT OF BEING SURE


A.I.A. FILE NUMBER 31-F-233
MANUFACTURER'S NAME
RLM
1960
Standard Specifications
Industrial Lighting Equipment
RLM Direct Fluorescent
RLM Glassteel Diffuser
RLM Semi-Direct High Mounting
RLM Deep Bowl
RLM High Mounting
RLM Special Service Fluorescent
RLM Dome
RLM Semi-Direct Fluorescent

PRODUCT QUALITY
LIGHTING QUALITY

These TWIN QQ's to Industrial Lighting Success are guaranteed with all lighting equipment bearing the RLM Label. And again for 1960, there are new and revised STANDARDS! They include: New Specs for 1500 MA HIGH MOUNTING FLUORESCENT units. Semi-Direct Porcelain Enameled and Aluminum units. • GROUNDING of all component parts. • CONTINUITY OF GROUNDING throughout a continuous row. • SILVER PLATED CONTACTS in all "rapid start" units. • NEW SYNTHETIC ENAMEL Specification for component parts cover (1) rust inhibiting undercoating (2) adhesion (3) hardness.

RLM STANDARDS INSTITUTE, Inc. Suite 8193, 326 W. Madison, Chicago 6, Ill.

Send free full information including the New 1960 Edition of the RLM SPECIFICATIONS BOOK. (Please write name, company and address in margin below.)

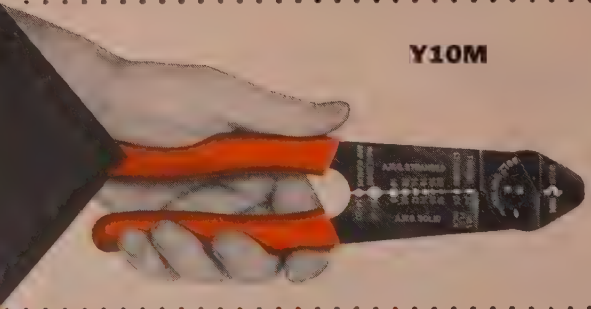
R-764

GET THE BIG 3

IN COMPRESSION-CONNECTOR TOOLING

1

Y10M



Light-weight hand tool installs a wide variety of HYDENT® connectors on wire sizes #22 thru #10. A wire cutter and single indentor die for all wire sizes are in the nose of the tool. Other features are wire stripper, bolt cutter, thread chasers, and dies for closing insulation-grips.

$3.95 ea

2

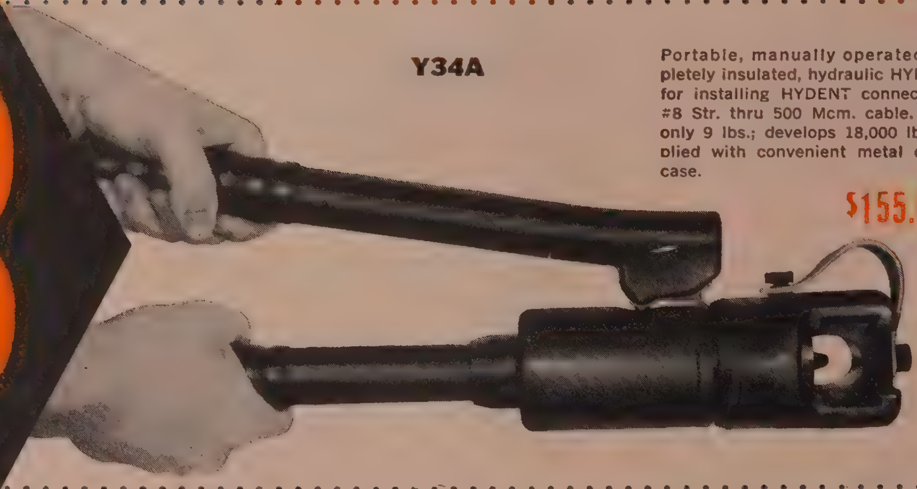
MY29-3

This HYTOOL® features one easily adjusted die set that installs HYDENT on commercial copper cable from #8 to 250 Mcm. and on aluminum conductors #8 to 4/0. Indexing plates are used for setting adjustable nest die for either copper or aluminum. No dies to install, change, identify or lose.

$36.00 ea

3

Y34A



Portable, manually operated, completely insulated, hydraulic HYPRESS® for installing HYDENT connectors on #8 Str. thru 500 Mcm. cable. Weighs only 9 lbs.; develops 18,000 lbs. Supplied with convenient metal carrying case.

$155.00 ea

Contractors with an eye on cutting connector installation time count on the Burndy Big 3. This Y10M, MY29-3, Y34A combination crimps practically every type and size compression connector on any job...adds the versatility, speed, and economy that result in profitable jobs. See your local Burndy distributor for demonstration.

BURNDY

59-15

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

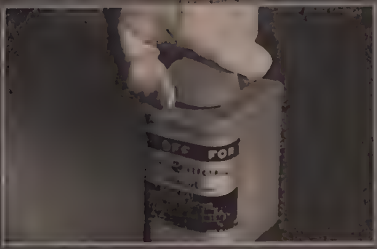
NEW

General Electric

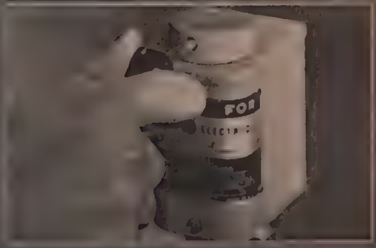
DRUM SWITCH

No tools needed to change from maintained to momentary contact

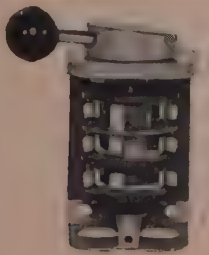
1. Unscrew handle and remove.



2. Lift cap slightly, turn 180°.



3. Reposition cap, replace handle.



FEATURES: Compact size • Shock-resistant construction • Visible long-life contacts • Large, easy-to-wire, screw-type terminals • Separate conduit openings for incoming and outgoing leads • Wrap-around cover with 180° accessibility for easy installation.

Built to last! Easy to install! Reliable "positive-feel" action!

For applications requiring manual control of travel direction, General Electric's new CR102 A1 Drum Switch offers exceptional durability plus convenience features that save installation and modification time.

Rated two hp, 230 volts single-phase and 600 volts polyphase, this new drum switch has a smooth handle action with solid "positive feel" that machine operators like.

Check the time- and cost-saving features at left. Ask your nearby G-E distributor for GEA-7000, or write to Section 733-51, General Electric Co., Schenectady 5, N. Y.

You get MEASURABLE ADVANTAGES with General Electric Control

GENERAL ELECTRIC

TAPES

YOU RESTORE THE DIELECTRIC WHEN YOU TAPE

Here are famous brands preferred by electricians wherever wire or cable must be repaired in utilities, factories or mining service. After the splice has been made, restore the dielectric qualities of your original insulation with a rubber tape and then protect its physical and abrasion resistance by an additional covering of friction tape.

U. S. SECURITY® FRICTION TAPE

Although competitively priced, this outstanding grade of electrical and general-purpose tape has all the characteristics of higher priced tape. It contains no pinholes — does not ravel when unwound from the roll — tears straight.

U. S. SECURITY RUBBER TAPE

The ideal commercial quality of unvulcanized rubber tape for all general electrical work.

U. S. Security rubber splicing compound possesses all the necessary physical properties: tensile elongation, tackiness and dielectric strength required for good, durable splices.

It is easy to handle and will fuse into a solid mass without the application of heat or undue pressure.

AND PHYSICAL QUALITIES
WITH "U. S."

U. S. HOLDTITE® FRICTION TAPE

Contains no free sulphur or other ingredients injurious to metals or fabrics. Exceeds all the physical requirements of the A.S.T.M. specification. Handles cleanly without raveling or waste—has no pinholes—has high dielectric strength for high voltage jobs.

It has unusually high tensile strength and strong adhesion and makes splices that are durable and lasting.

U. S. HOLDTITE SPLICING COMPOUND

A high-grade rubber splicing compound exceeding A.S.T.M. requirements.

U. S. Holdtite rubber splicing compound is economical when considered on a cost-per-foot basis. Its high dielectric strength, combined with its fine tackiness and fusing qualities, insures perfect splices.

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y.   In Canada: Dominion Rubber Company, Ltd.

Ceiling diffusers, counter lighting and identification panels of PLEXIGLAS *at Port Columbus Airport, Columbus, Ohio*

PLEXIGLAS

FOR LIGHTING THAT STANDS OUT AND STANDS UP

The versatility of PLEXIGLAS® acrylic plastic as a lighting material is well demonstrated in the multiple uses shown above. To each application, PLEXIGLAS brings maximum efficiency in the transmission and diffusion of light. It also provides breakage-resistance, ease of cleaning, and freedom from discoloration. Above all, PLEXIGLAS has the permanent, quality appearance that complements good interior design.

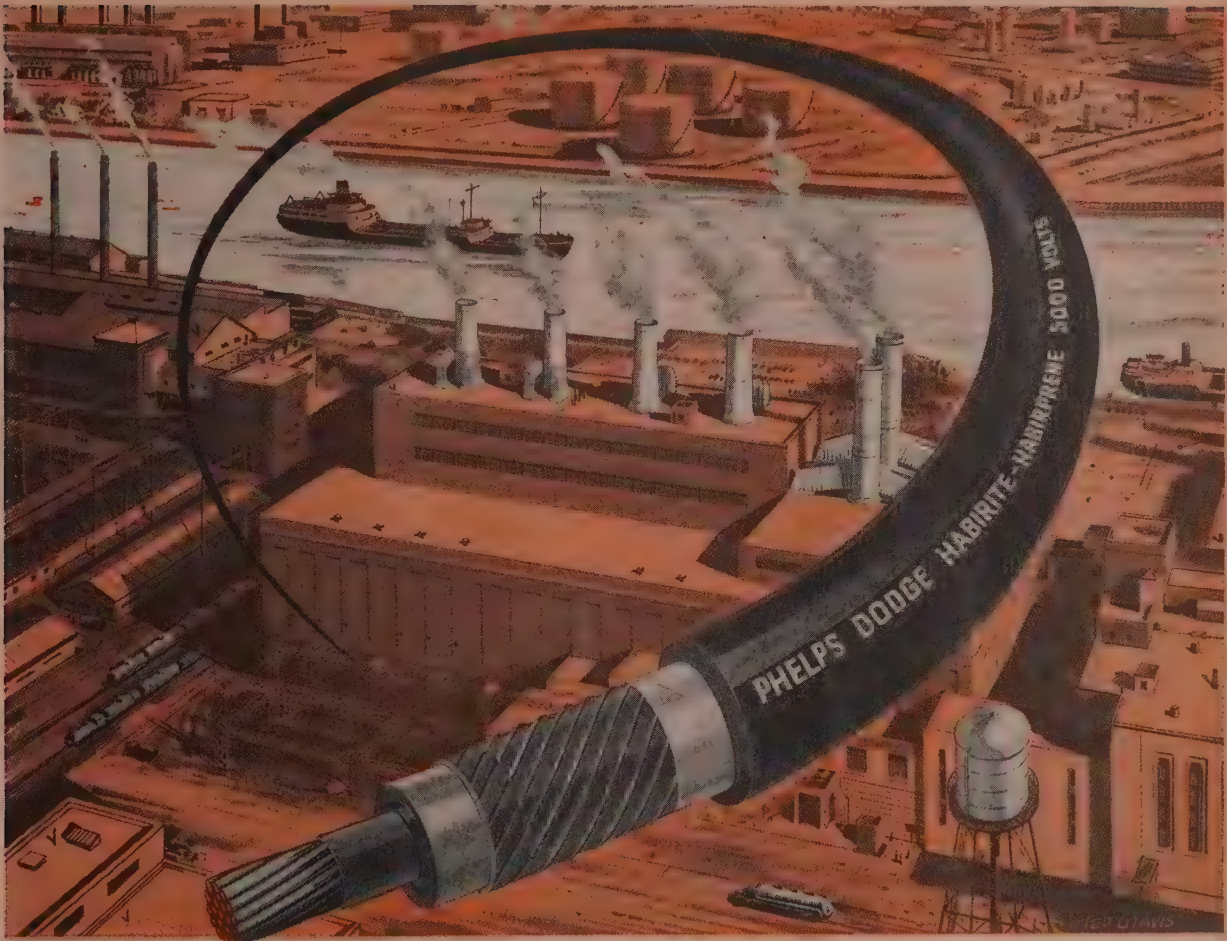
We will be pleased to send you the names of manufacturers of lighting equipment that incorporates PLEXIGLAS.

Chemicals for Industry

ROHM & HAAS
COMPANY
WASHINGTON SQUARE, PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Company of Canada, Ltd.,*
West Hill, Ontario

WHEN ORDERING "TYPE RR" CABLE...



SPECIFY HABIRITE-HABIRPRENE

The high voltage cable that assures superior quality and service reliability!

The term "RR" is only a name, not an assurance of quality. Instead of ordering just "RR" cable, insist on Phelps Dodge *Habirite-Habirprene*—developed through years of experience in designing and manufacturing this type of cable.

Phelps Dodge Habirite insulation, a specially engineered butyl rubber compound, has a service dependability record unsurpassed by other types of rubber insulation. Habirite is greatly superior to old-fashioned insulation for these reasons:

- Much greater resistance to heat and oxidation which permits a higher temperature rating, with consequent reduction in conductor size and in cost for same current load.
- Much greater resistance to ozone usually present around high voltage equipment.
- Better electrical properties that give a greater safety factor in operation.

Phelps Dodge Habirprene sheath, a neoprene compound with improved mechanical toughness against damage from installation hazards, is especially made to be extra resistant to corona, one of the worst enemies of high voltage cable. This extra resistance provides a greater safety factor in operation and has contributed to the remarkable reputation and service record of *Habirite-Habirprene.*

When you specify *Habirite-Habirprene*, you are assured of high voltage cable with the utmost in safety and durability. *See your Phelps Dodge Distributor!*

PHELPS DODGE COPPER PRODUCTS
CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

GROW FAST

WITH Cavalier ELECTRIC HEAT

Ride the tide of popular demand for Cavalier automatic electric heat.

Most often, Cavalier electric heat is the ideal installation for new homes or old, offering more flexibility in planning, more comfort for the user. Cavalier heat is the simplest ever devised, is easily installed and guarantees years of trouble-free service. You'll find it easy to promote.

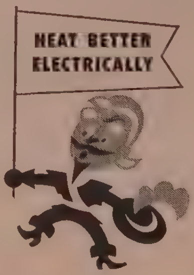
A wealth of engineering and merchandising service is available at Cavalier. If you would like help in getting your share of this important and fast growing market, just let us know.

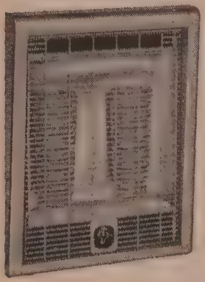
Merchandising help — National advertising is backed by folders, inserts, ad-mats, posters, displays, trade shows, radio and TV spots and the whole range of promotional activities to help you **GROW** with **CAVALIER.**

Cavalier . . . THE COMPLETE LINE

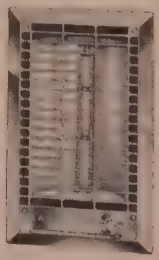
GUIDE FOR CALCULATIONS OF ELECTRIC SPACE HEATING enables you to determine what Cavalier units are needed and where they should be placed. This working manual also covers loss, insulation requirements, cost of operation, etc.

Cavalier Electric Baseboard
Built-in Thermostat • Corner Piece
End Caps • 115 V Duplex Outlets

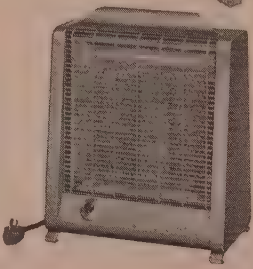




Cavalier Wall Insert
1 to 5 KW



Cavalier Bathroom
Automatic and non-automatic
120 and 240 volt



Cavalier Portable
2, 3, 4 KW

Cavalier
Radiant Cable

HIGHEST QUALITY Electric Heating Equipment sold only through trade channels to safeguard the consumer, the contractor and the distributor.

ELECTRIC HEATING DIVISION **CAVALIER CORPORATION** CHATTANOOGA 2, TENNESSEE

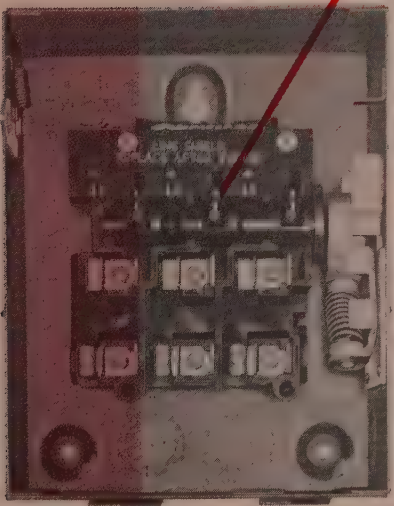
OUR 95th YEAR
OF QUALITY PRODUCTS

FIRST

in quality construction
in engineering advances
in safety
in sales making features

For extra safety...

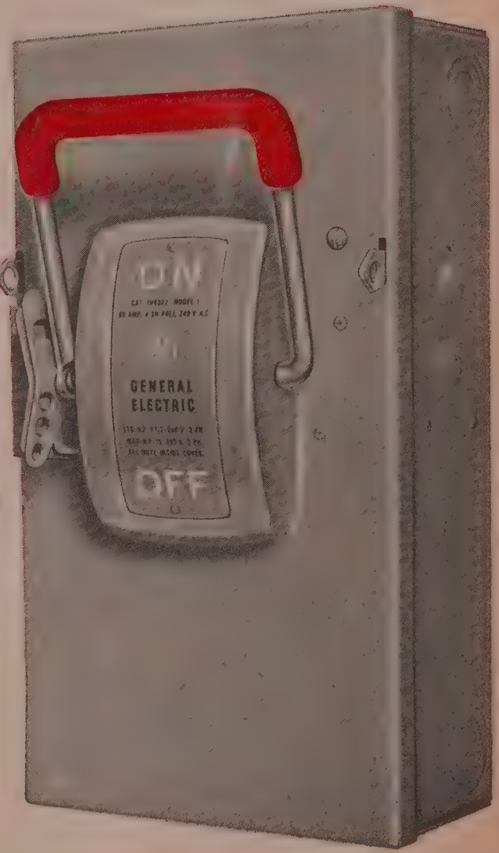
GET THE SWITCH WITH THE RED HANDLE!



You can see the contacts— Silverplated blades are plainly visible, spring reinforced for full, firm electrical contact.

No wire abrasion

Side wiring gutter is unobstructed—free of moving parts which can chafe and wear wire insulation.



These features mean extra safety for you: Vivid red handle is insulated, provides ON-OFF identification from over 100 feet away; safety phase barrier protects against accidental contact with live parts; no fiber linkages in mechanism to deteriorate with age, moisture or heat; complete locking provision; mechanical interlock and line shield (Heavy Duty). Heavy Duty (Type A) sell at Normal Duty (Type C) price levels. Write for Bulletin CPD-74. See your G-E distributor for a demonstration.

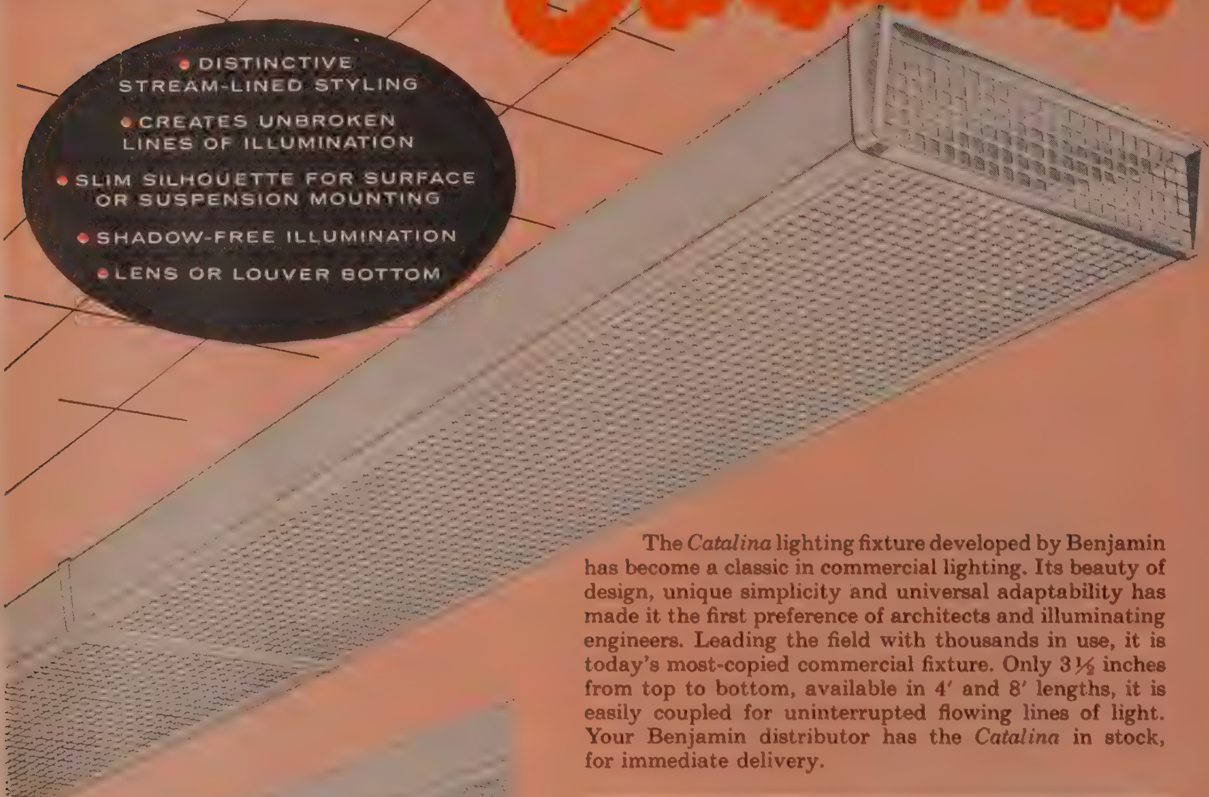
GENERAL ELECTRIC

Circuit Protective Devices Dept., Plainville, Conn.

YOU GET THE
ORIGINAL
[illegible]
WHEN YOU
SPECIFY...

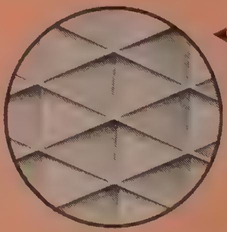
THE CLASSIC

Catalina



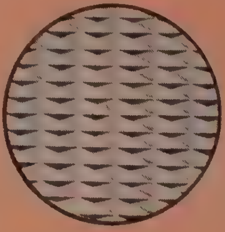
- DISTINCTIVE STREAM-LINED STYLING
- CREATES UNBROKEN LINES OF ILLUMINATION
- SLIM SILHOUETTE FOR SURFACE OR SUSPENSION MOUNTING
- SHADOW-FREE ILLUMINATION
- LENS OR LOUVER BOTTOM

The *Catalina* lighting fixture developed by Benjamin has become a classic in commercial lighting. Its beauty of design, unique simplicity and universal adaptability has made it the first preference of architects and illuminating engineers. Leading the field with thousands in use, it is today's most-copied commercial fixture. Only 3½ inches from top to bottom, available in 4′ and 8′ lengths, it is easily coupled for uninterrupted flowing lines of light. Your Benjamin distributor has the *Catalina* in stock, for immediate delivery.



◀ **SPARKLING PLASTIC LOUVERS** Benjamin's own one-piece polystyrene 45° x 45° louver with ½ inch cube.

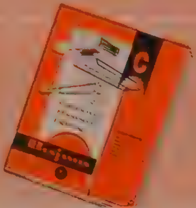
GLISTENING L-120 LENS ▶ Benjamin's exclusive polystyrene L-120 lens combining low-brightness with prismatic light diffusion.



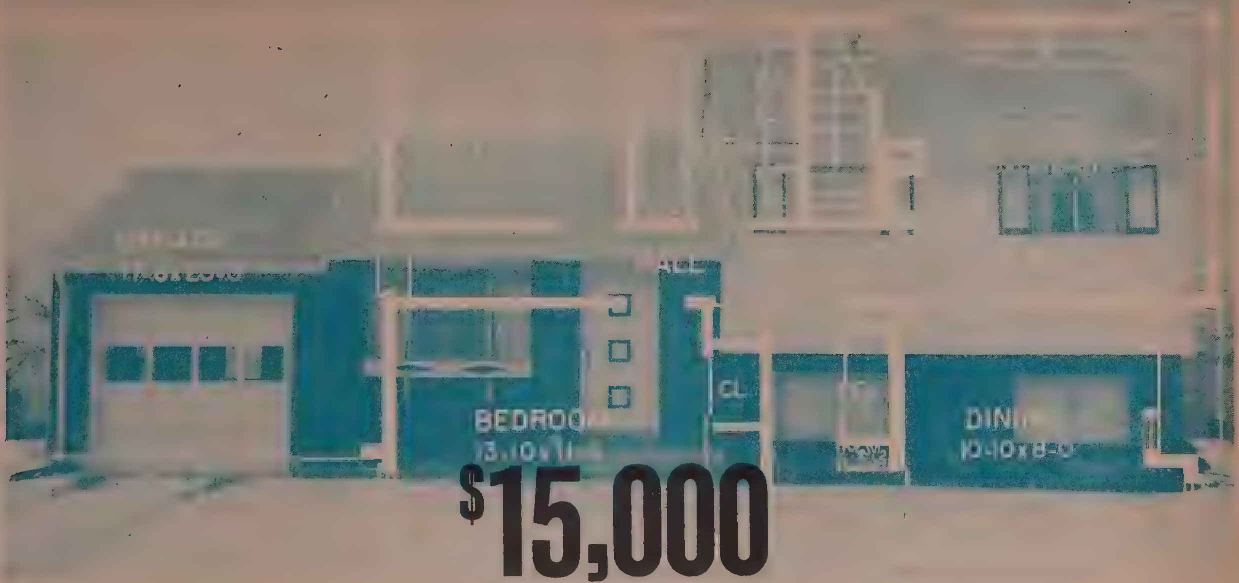
BENJAMIN
DIVISION Des Plaines, Ill.

THOMAS INDUSTRIES INC.

BENJAMIN • MOE LIGHT • STAR LIGHT • ENCHANTE • SAN MARINO



WRITE TODAY for complete information—ask for Bulletin C: Benjamin Division, Thomas Industries, 207 E. Broadway, Louisville 2, Ky. Dept. ECM-3B.



$15,000
OR
$50,000

REMCON LOW-VOLTAGE SWITCHING—FOR ANY HOME!

Sidney Gotowner, Gotowner Electric, Rego Park, L. I. "Even the man who spends $15,000 for a home has a right to luxury, and Remcon helps me provide it at a profit! I can build in three- and four-way switching quickly—at *lower labor costs*—because Remcon's #18 wire ends the need to run heavy armored cable. And the transformer's in the relay. I'm sold, and my tracts go just as fast."

Ephraim Berkowitz, Turnpike Electric, Franklin Sq., L. I. It's the little touches that make Remcon so appealing to my clients...remote control of any light in the house from as many high-fashion switches as they wish...master control convenience from the bedroom to save steps...path-of-light safety to eliminate fumbling in the dark. And the beauty of it is Remcon is a 'plus' that's practical in *any* home."

Find out how versatile and flexible Remcon can be in your houses. Send in your plans for a free wiring diagram and estimate.

REMCON

a Division of Pyramid Instrument Corp.,
630 Merrick Road, Lynbrook, N. Y.

CENTURY MOTORS PULL HEAT

Forty-two stories above Dallas, on top of the South's tallest building, three Century 50 horsepower totally-enclosed fan-cooled motors are driving induced draft fans to keep the Southland Center cool.

A Century motor drives a 20-foot fan on each of three cells of this cooling tower. During the hot summer months, especially, the air conditioning of the immense Southland Center is dependent upon the continuous operation of these fans—and, upon the dependable, continuous operation of Century motors.

Heat absorbed by air-conditioning and refrigerating equipment must be removed efficiently. Maintaining efficient condensing temperature in a system of this large capacity, requires 20,000 gpm of cold water. And conservation of this gallonage with uniform performance at all times is necessary—the cooling tower is an important factor in the overall system.

Dependable Century motors are a vital part of installations such as this one where the continuous operation of the fans is so important. The three Century 50 horsepower, two-speed, totally-enclosed fan-cooled motors used in this installation are subject to all sorts of

OUT OF A 42-STORY BUILDING

unfavorable weather conditions—heat, moisture, rain, wind, corrosion. But they keep working . . . continuously. They keep working because these motors are made of strong, tough cast iron and will withstand the elements in unguarded outdoor locations.

These totally-enclosed fan-cooled motors are constructed so that no outside air (with dust, dirt, moisture, etc. in it) is circulated into the motors. Internal fans circulate *clean* air within the enclosed frames. An external fan blows air over the ribbed frames for maximum transfer of heat to the outside air. These Century motors can take it, because they are designed and built to handle such jobs.

Century application engineers throughout the country understand industry's motor requirements. Call the Century Office nearest you, or your Authorized Century Distributor for more information about Century's complete line of motors—from 1/20 to 400 horsepower.

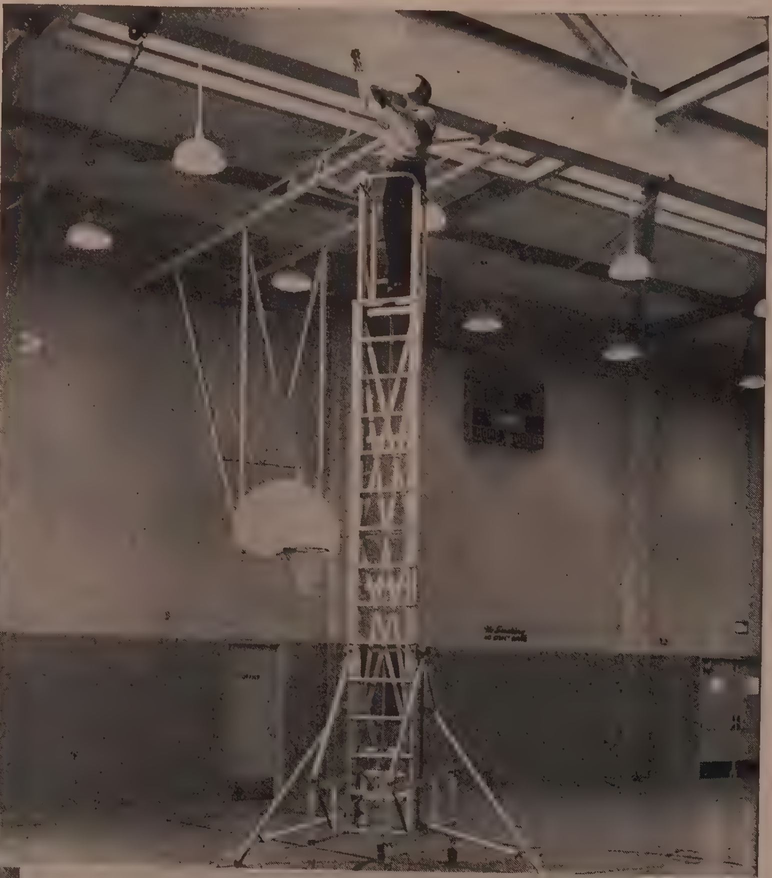
CENTURY ELECTRIC COMPANY Century

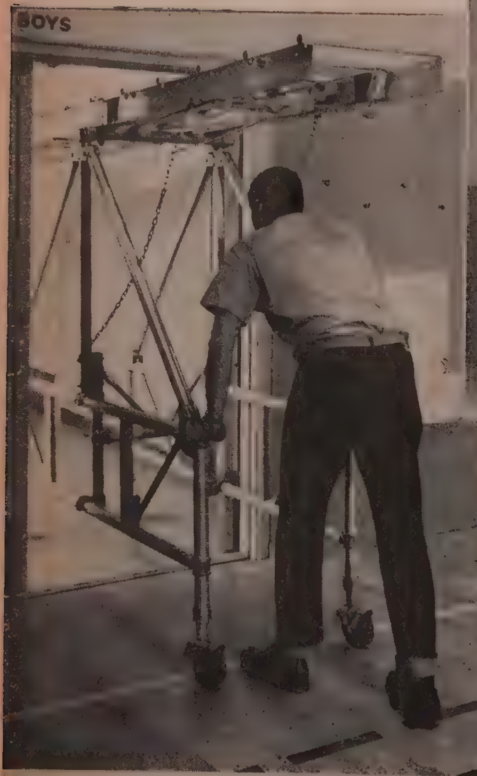
St. Louis 3, Missouri *Offices and Stock Points in Principal Cities* 59-24

UP-RIGHT ANNOUNCES

TALLESCOPE ...telescoping aluminum work platform for overhead construction and spot maintenance

Lightweight, rapidly assembled by one man. Extends instantly for reaching heights up to 30 ft. Telescopes for rolling under trusses and other obstacles. Adjustable legs for uneven floors or stairways.





Rolls through doorways . . . only 29" wide, telescopes and folds down.

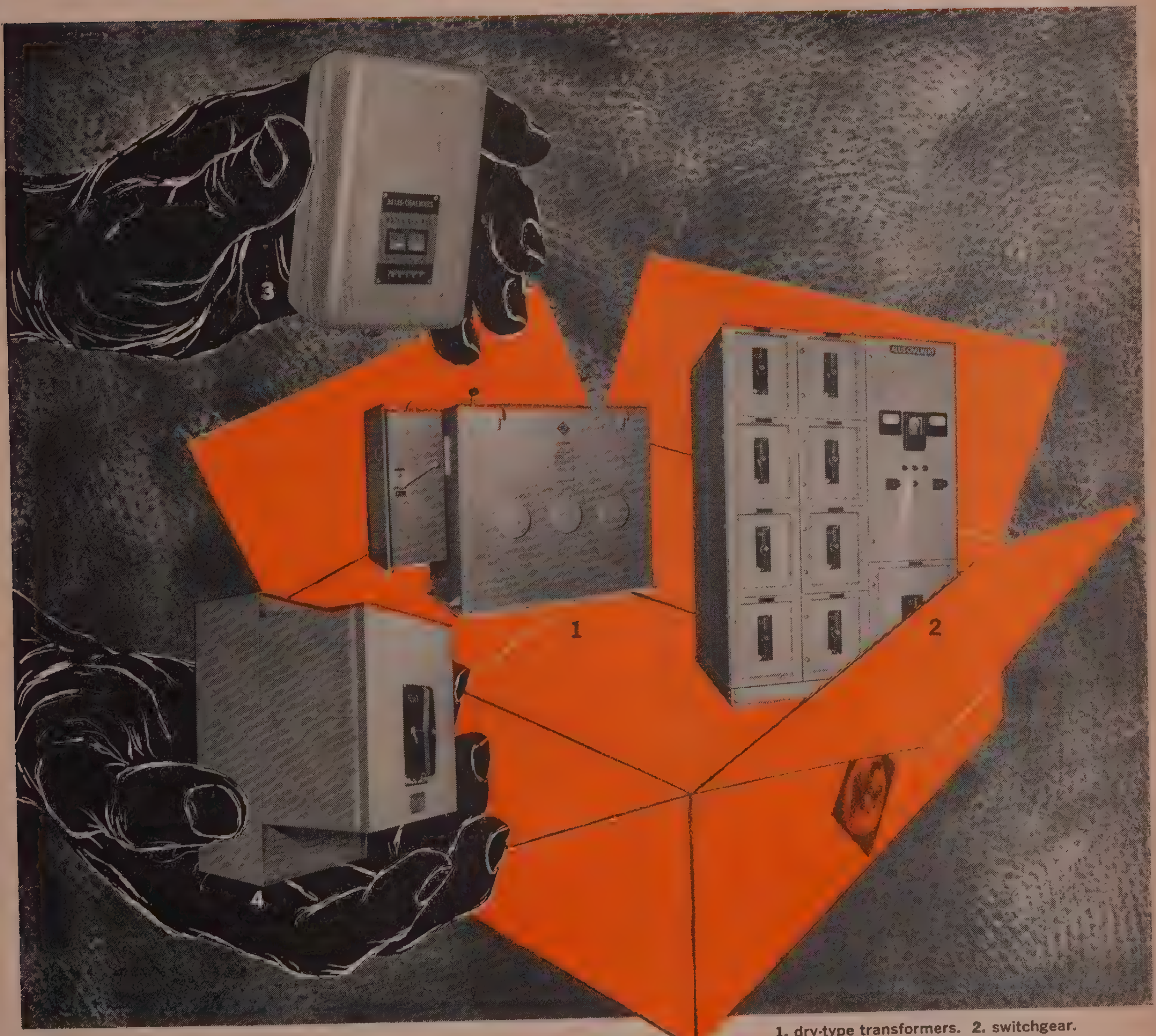
Bridges over auditorium seats.

Separates easily into 3 components for convenient storage or transportation.

FOR TALLESCOPE CIRCULAR
WRITE TO
UP-RIGHT SCAFFOLDS
DEPT. 177 • 1013 PARDEE ST., BERKELEY, CALIF.

MANUFACTURED BY
UP-RIGHT SCAFFOLDS

ALLIS-CHALMERS



1. dry-type transformers. 2. switchgear.
3. motor control. 4. circuit breakers.

Allis-Chalmers system-selling package concept

wraps up new profits for you

One man gives you all the electrical products for wrapping up new profits on system sales and installations! One man coordinates specs, orders, delivery, installation scheduling. One man personally represents Allis-Chalmers — exercises single-source responsibility from initial planning to startup and he is ready to follow through on fast spare parts action.

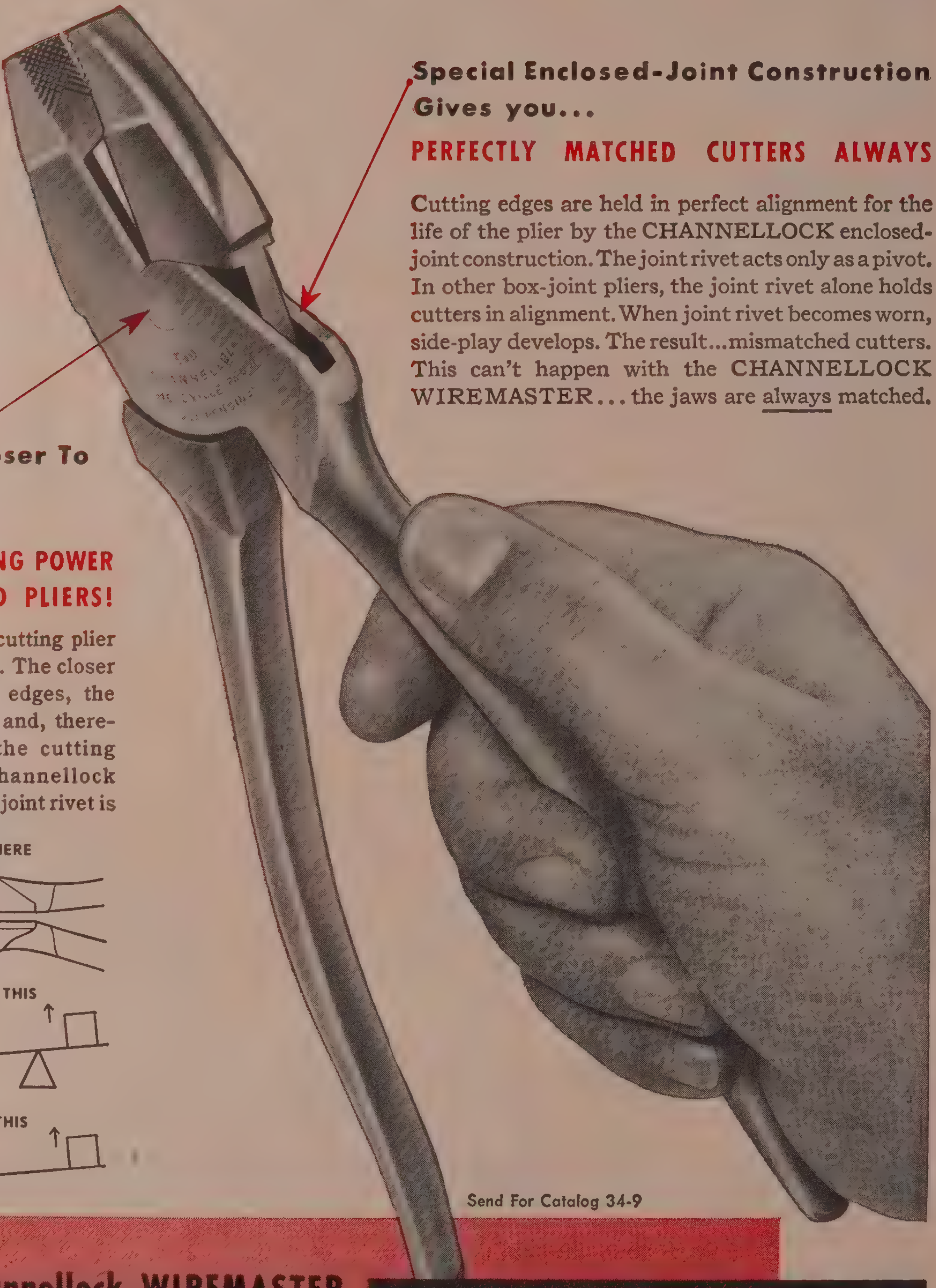
Why not wrap up new profits by eliminating needless multiple supplier headaches? You can accomplish this with the Allis-Chalmers system-selling packaged products shown on the following pages. *Your nearby A-C office can quickly give you the complete facts, or write* ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

A-1267

40% More Cutting Power... *Yours* With the New

CHANNELLOCK® No. 349 WIREMASTER

LINEMEN'S AND ELECTRICIAN'S PLIER



Special Enclosed-Joint Construction Gives you...

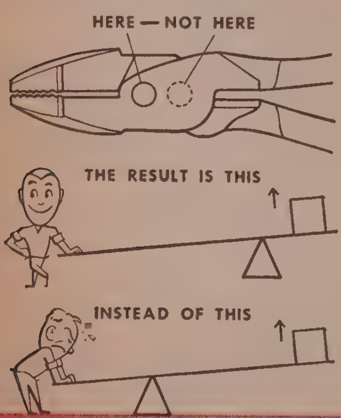
PERFECTLY MATCHED CUTTERS ALWAYS

Cutting edges are held in perfect alignment for the life of the plier by the CHANNELLOCK enclosed-joint construction. The joint rivet acts only as a pivot. In other box-joint pliers, the joint rivet alone holds cutters in alignment. When joint rivet becomes worn, side-play develops. The result...mismatched cutters. This can't happen with the CHANNELLOCK WIREMASTER... the jaws are always matched.

Joint Rivet Closer To Cutting Edges Gives You...

40% MORE CUTTING POWER THAN STANDARD PLIERS!

The joint rivet in a cutting plier is basically a fulcrum. The closer it is to the cutting edges, the greater the leverage and, therefore, the greater the cutting power. In the Channellock WIREMASTER, the joint rivet is

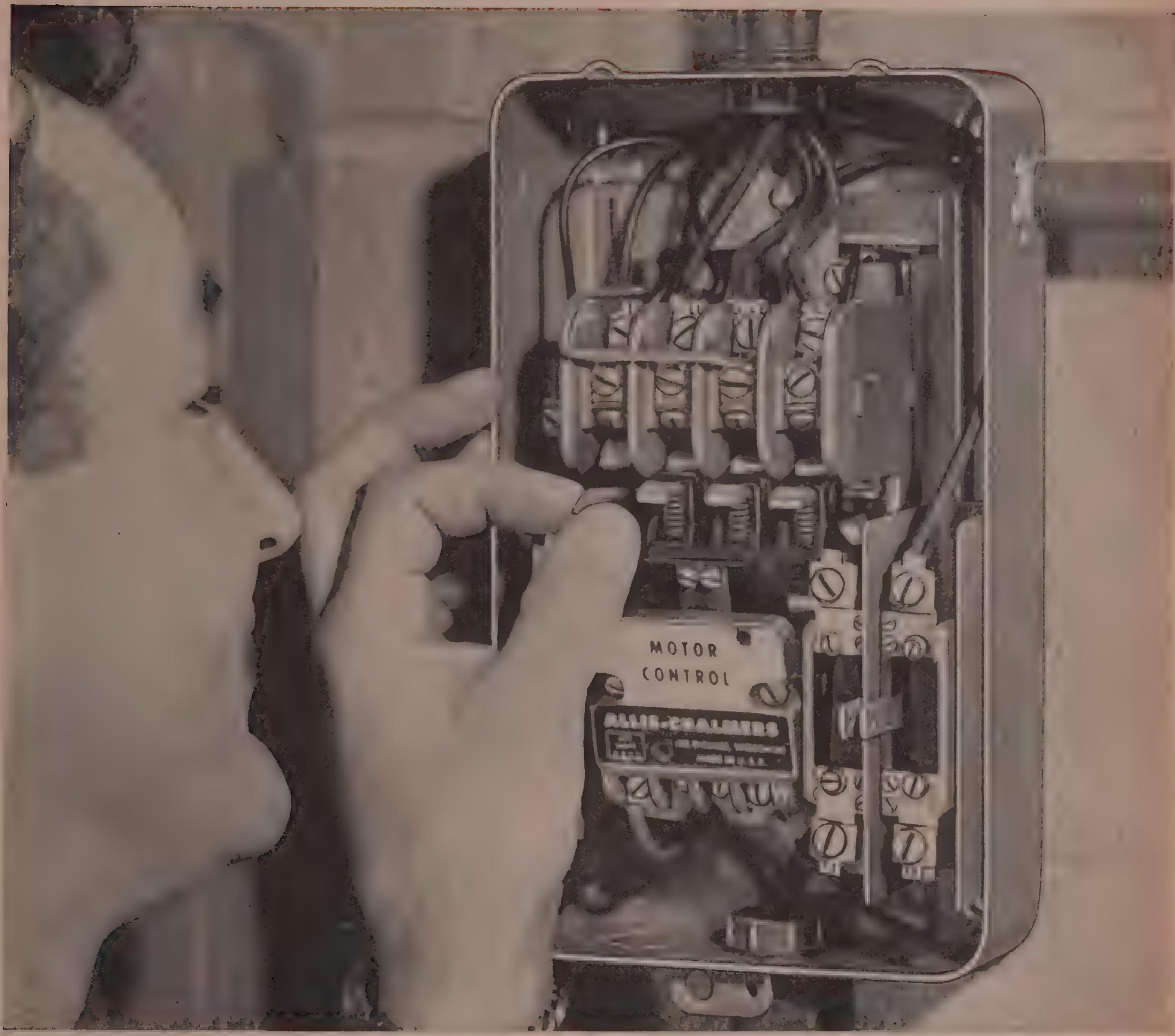


Send For Catalog 34-9

Only the Channellock WIREMASTER Gives You BOTH These Features

CHAMPION DeARMENT TOOL COMPANY
MEADVILLE, PENNSYLVANIA, U. S. A.

ALLIS-CHALMERS



New complete line of low-voltage motor control

wide open for fast wiring . . . inspection

Wide-open accessibility and modern design assure fast and easy installation, modification, inspection and maintenance of this new line of Size 0 through 4 Allis-Chalmers control. For instance, large and clearly marked terminals, pressure connections for all wiring, wide and deep-cut screw slots, clearly visible contacts, easy coil replacement, readable rating plates, "out-front" overload relays.

Flexibility

This new line of control permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

Unsurpassed Mechanical and Electrical Life

Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

A complete line of low-voltage control (Size 0 through 9) and high-voltage control *in all NEMA* enclosures, plus engineered control systems. Your A-C distributor or representative will give you all the details. Or write **Allis-Chalmers,** General Products Division, Milwaukee 1, Wisconsin.

A-1232

“If we had had Exide Lightguard

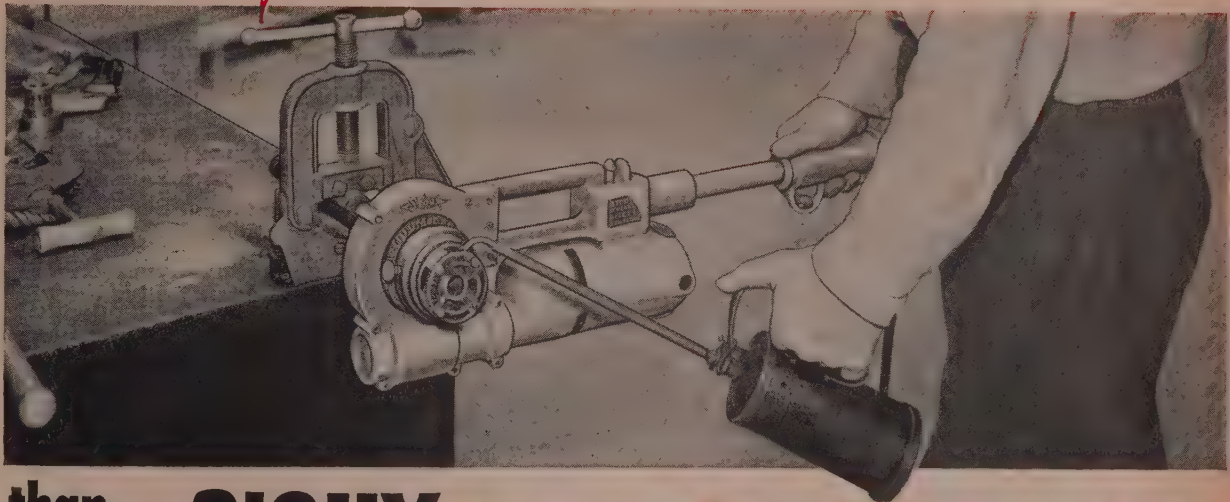
we would have saved many times the cost—by preventing losses from pilferage, damage and injuries in this single power failure.”

Don’t let it happen to you. Install Exide Lightguard.* Plug into regular outlet—it goes on automatically when lights go out. Built-in automatic charger. Batteries last for years. Choice of several models. Be protected against panic, theft, damage, personal injuries. For full details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

*Reg. TM Electric Storage Battery Co.

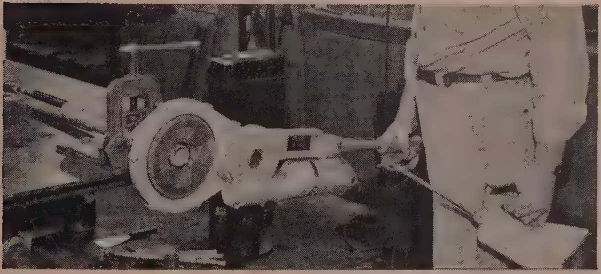
Exide®

"Nothing Ever Saved More Time"....



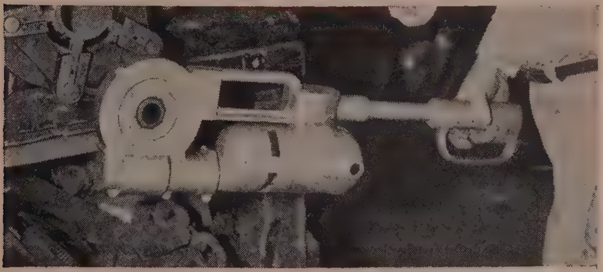
than the new SIOUX Power Pipe Threader!

WITH THE SIOUX POWER PIPE THREADER you can thread ¼″ to 1″ pipe in 20 seconds; 1″ and 2″ pipe in one minute, 24 seconds! When labor costs 6½ cents per man per minute, a power tool like this for which there is a continuing need doesn't take long to pay for itself. The SIOUX Power Pipe Threader is said to be saving more time and money than any other major portable power tool!



SIOUX NO. 1508 PIPE THREADER in use with No. 1511 Speed Reducer.

THREAD PIPE ON THE JOB, in a hurry. Once the unit is in place it only takes one hand.



DRIVING GEARED DIE STOCK with SIOUX No. 1508 Pipe Threader and No. 38002 Adaptor.

WIRE IS PULLED THROUGH CONDUIT with SIOUX No. 1508 Pipe Threader and No. 1509 Portable Winch.

Your SIOUX Power Pipe Threader will also thread bolts; drill; auger; and open and shut valves. (It's a versatile, portable power package!)

SIOUX

Look for SIOUX in the yellow pages under "Tools, Electric" or write to

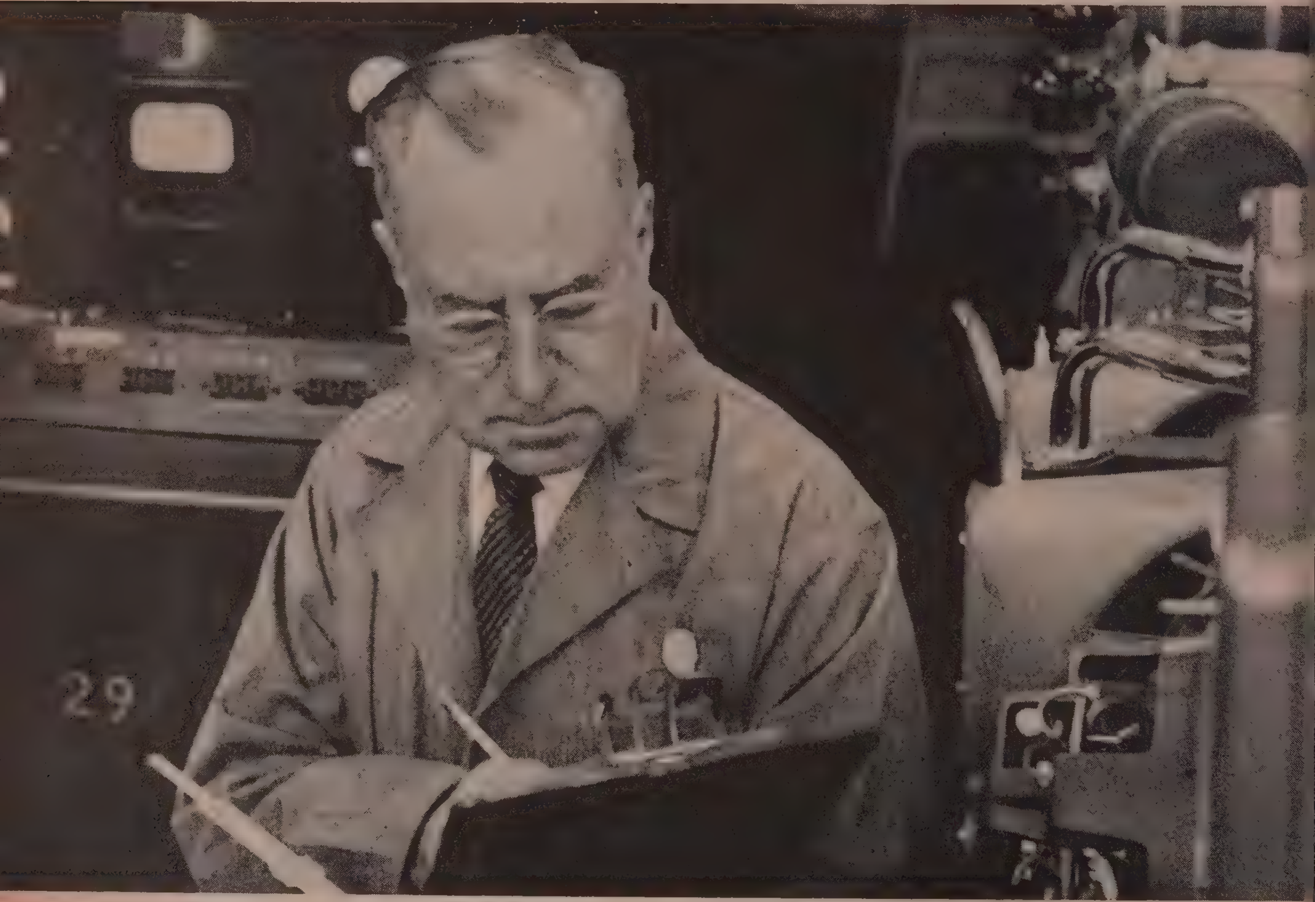
ALBERTSON & CO., INC.

SIOUX CITY, IOWA, U. S. A.

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • ELECTRIC IMPACT WRENCHES • DRILLS • SCREWDRIVERS • GRINDERS • SANDERS • POLISHERS • FLEXIBLE SHAFTS • PORTABLE SAWS • VALVE GRINDING MACHINES • ABRASIVE DISCS

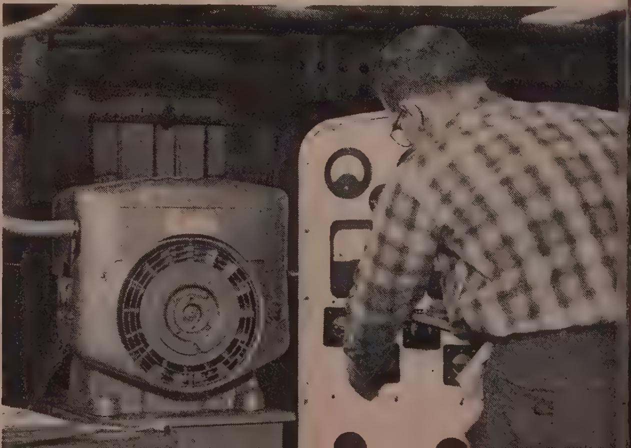
Onan Electric Plants are

when this independent



Big, beefy bearings for longer life. (Lower left) double-size Onan bearings vs. small bearings (right) used in many other makes. Larger bearing surface reduces wear, stretches time between overhauls. Onan builds up to performance—never down-to-a-price.

The engine that ran equivalent to 487,888 automobile miles. Here's endurance no auto could begin to match. Onan engine #1068 was operated for 12,197 hours. It was stop-started 100 times. At test's end #1068 and generator were delivering their stated output.



Performance Certified only tester says O.K.

His job is to provide a double-check on Onan's own tests and testing methods

The man at the left is an expert from an independent testing laboratory. On the job, he believes nothing except what his trained eyes, ears and scientific testing instruments tell him.

He, and others like him, pay frequent surprise visits to Onan factories. He can pull any Onan plant off the test line. Put it through its paces. Recheck the checks Onan engineers and inspectors have already made. He has authority to pull a whole series of plants off the line if he finds one fault. He does all this even though every Onan plant is tested for hours by Onan personnel *before it is shipped.*

Onan takes these special precautions to make *doubly* sure that you get all that you pay for, and more, when you own a Performance Certified Onan. For more details—and an analysis of your primary and stand-by power needs—see the Onan distributor nearest you. He's listed in the telephone classified section in all major cities. Or write direct.

ONLY ONAN GIVES YOU THIS GUARANTEE

PERFORMANCE CERTIFIED

We guarantee that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.

D. W. ONAN & SONS INC.
Minneapolis 14, Minnesota

Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2510 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

ONLY ONE **HIGHEST**

The highest mountain on the North American continent is Mount McKinley in our 49th State, Alaska. It towers 20,320 feet above sea level and rises higher above the surrounding country than any other mountain in the world. Bronco 66 Certified is first choice for use in these freezing, rocky heights because the high Neoprene content in the jacket gives it unexcelled flexibility in cold weather as well as maximum abrasion resistance.

BRONCO
Certified **66**
NEOPRENE

PORTABLE ELECTRICAL CORD AND CABLE

has the
HIGHEST NEOPRENE
content in the industry

...at no extra cost. Outer protecting jacket contains not less than 67.32% Neoprene and is so certified by a Registered Professional Engineer. When you buy Bronco 66 Certified, you get the most Neoprene for your money . . . hence, maximum protection from oil, acids, alkalis, heat, cold, flame. Always specify Bronco 66 Certified and enjoy **the long term economy of top quality.**

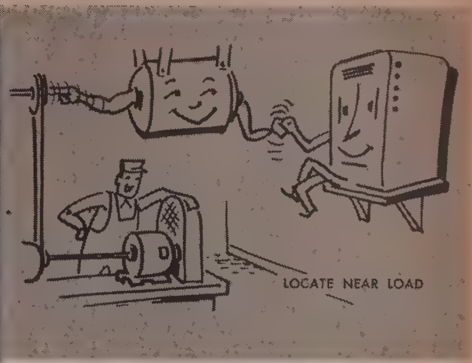
Self-measuring jacket is branded every two feet by a patented Bronco process—U. S. patent No. 2867001. Complete identification is molded into the jacket so it won't rub off.

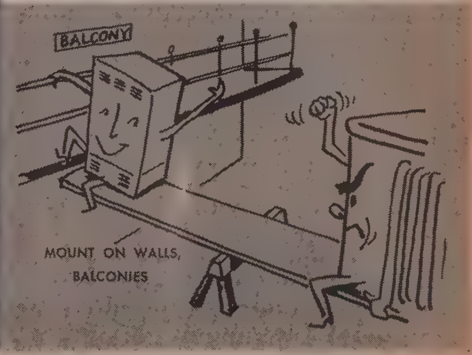
Buna rubber insulation is built to exceed ASTM D-755 test requirement. Jacket and insulation are Synchro-Cured, the exclusive Bronco process of vulcanization, to work as an indefatigable team.

WRITE FOR FREE SAMPLE! → **WESTERN INSULATED WIRE CO.**
Los Angeles 58, California

SILICONE NEWS from Dow Corning

Power Where You Want It





Check Inside: Where a Transformer Can be Located Is Largely Determined by its Insulation!

Whether you're modernizing or installing a completely new power distribution system, you can make certain that transformers will fit easily into any plant layout by specifying silicone insulated dry-type units.

Locate them near the load . . . on the floor, a balcony or the wall . . . anywhere! Insulated with Dow Corning Silicones, they are light-weight . . . space saving. Frequently no more expensive initially, they cost less to install, less to maintain, far less in the long run. Here's why:

Lowest Cost Installation: Easier to handle and easier to install, they require no costly vaults or barriers . . . can be placed right at load or load center for additional savings on costly low-voltage cable.

Lower Operating and Maintenance Costs: Virtually maintenance-free, silicone insulated transformers have no liquids to filter or change. Need no space heaters to keep windings dry when de-energized.

Maximum Reliability: Depending on design, they withstand overloads of 25% to 50% and more above rated capacity. The extra thermal capacity of silicones assures uninterrupted, reliable power.

Maximum Safety: Completely dry and completely safe, you can locate silicone insulated, dry-type transformers almost anywhere! No danger of fire . . . no toxic fumes. These units prove safe even under extreme overload and short circuit conditions.

Today, transformer manufacturers offer two basic designs insulated with Dow Corning Silicones — *sealed* and *open* dry-types.

For Load Center Unit Substations, you can achieve maximum reliability and minimum maintenance with a silicone insulated *sealed* dry-type unit. Requires only a periodic check of pressure gauge and bushings.

Or you can save weight by specifying a silicone insulated *open* dry-type unit. Up to 40% lighter than non-inflammable liquid filled units, they're ideal for balconies and other minimum floor loading areas.

Lighting Transformers and wall-mounted units are lighter per KVA than any other type. Locate them right at the load and save valuable floor space. They provide uninterrupted reliable power despite contaminated atmospheres, dust, dirt, moisture or high ambients.

Send today for full information on silicone insulated, dry-type transformers and list of manufacturers offering equipment insulated with Dow Corning Silicones. Address Dept 3903.

SPECIFY Dow Corning Silicones and SAVE!

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA [redacted] CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

For dependable protection of electrical wiring . . .

USE RIGID STEEL CONDUIT

When you install rigid conduit made of steel, you obtain *permanent* protection against the ever-present hazards of faulty electrical circuits.

The proof is in the performance of thousands of steel conduit installations over the past 50 years. And the reasons are simple:

Strength and toughness

Steel prevents physical damage to the wires, protecting them permanently.

Good electrical conductivity

Steel carries off dangerous fault currents to remove the threat of fire and shock.

Heat resistance

Steel conduit prevents possible fire from spreading to the building.

Rigid steel conduit is inexpensive to buy, easy to install, simple to rewire. It's compatible with all construction materials in major use, and will often outlast the building itself. Ask your nearest electrical distributor for full details.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

For emergency stopping... NEW ASCO BREAK-GLASS SWITCH

In a fire, the quick stopping of equipment such as oil burners and ventilators, can reduce the danger of the fire spreading or explosion. ASCO Break-Glass Switches provide a fast means of stopping equipment from any point throughout your plant.

When glass in switch is broken, switch contacts open and equipment stops. Contacts remain open until glass is replaced.

Designed for use with oil burners, ventilators, air conditioners, refrigeration and a variety of other equipment, ASCO switches feature heavy-duty contacts and solid brass construction for maximum reliability.

They are available single pole, single and double throw, for 2 or 3 wire control devices. Interrupting capacity: 5 amps. at 250V. A-C; 10 amps. at 125V. A-C. Switches come equipped with hammer and have emergency instructions clearly displayed on cover.

For complete information write for Bulletin 124.

Important news for contractors and consulting engineers!

Effective June 1, 1959 New York City Department of Buildings requires each ventilating installation be equipped "with a manual emergency stop located at a conveniently accessible point for quick shutting down of all fans in case of fire."

ASCO Electromagnetic Control

Automatic Switch Co. 50-J HANOVER RD., FLORHAM PARK, N. J., FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

Four big savings

you get only with trouble-free UNISTRUT® framing

***Refineries save** with UNISTRUT framing. No extensive prefabricating, drilling or field fitting was needed to mount the pipe and conduit here. Using the UNISTRUT system, a precision framing and supporting job was done on the job.*

SAVING #1

Changes—no problem. Meeting unusual job conditions or making field changes can run up costs in a hurry. But not when you use UNISTRUT framing. Completely adjustable, UNISTRUT framing enables you to adjust to any job condition right on the job. Often a wrench is the only tool needed.

SAVING #2

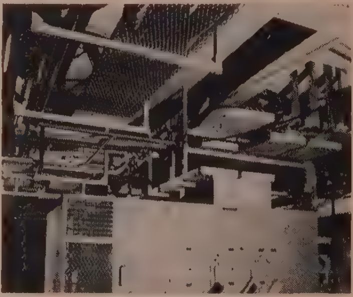
Errors—can't happen. Errors in prefabrication or installion can cause delays, waste time. But UNISTRUT framing is error-proof! A precise installation is made quickly and easily *right on the job.*

SAVING #3

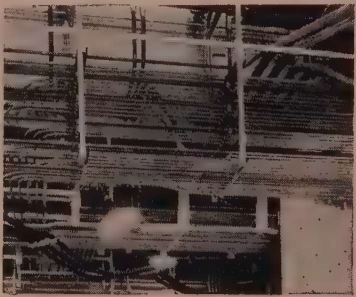
Delivery delays—can't happen. Fast *local* service is a plus offered by your Unistrut distributor. He stocks everything you need *where you are.*

SAVING #4

No multiple source mix-ups. Buying, follow-up and coordinating from multiple sources is time-consuming and costly. The completeness of the UNISTRUT system provides all your framing, hanging and supporting needs from *one* source. Your local Unistrut distributor stocks more than 1,400 standard fittings plus dozens of channel sizes and combinations.



***Utilities save** with UNISTRUT framing. Here UNISTRUT drop frames, suspended from UNISTRUT concrete inserts, are used as cable tray supports: same frames also support conduit runs.*



***Contractors save** with UNISTRUT framing. In this job UNISTRUT framing enabled close grouping of conduit for a big saving in space. System can be added to or changed at any time.*

Mr. Strut says:
"See your local Unistrut distributor or write for catalog."

UNISTRUT®

PIONEER IN ADJUSTABLE METAL FRAMING

UNISTRUT PRODUCTS COMPANY

GENERAL OFFICES: 941 West Washington Blvd., Chicago, Illinois
Telephone: MOnroe 6-2665 Teletype: CG 1329

Stocking distributors in all principal cities of the United States and Canada. Exported throughout the world.

WORLD'S MOST WIDELY USED ELECTRICAL TEST INSTRUMENTS

AMPROBE®

THE ONLY LINE THAT COVERS ALL YOUR TESTING NEEDS

The original pocket size snap-around volt-ammeter-ohmmeter

AMPROBE RS-3

5 current ranges. 3 voltage ranges. Ohmmeter specially designed for the maintenance field. Rotary scale for faster reading and greater accuracy. Pointer-Lock "freezes" pointer at reading. Advanced printed circuitry laughs at rough handling. Advanced movement design—new internal core magnet with self shielding characteristics. **By itself, the Amprobe RS-3 handles 99% of your test needs. With the Amprobe Deca-Tran and Amprobe Energizer it covers EVERY testing situation.** *Only* **$52.50**

AMPROBE RS-1

The economy snap-around volt ammeter with many features of the great RS-3 including rotary scale, pointer lock, printed circuit, and advanced movement design. 4 current ranges. 2 voltage ranges. *Only* **$39.85**

AMPROBE JR.

The advanced voltage tester that gives you current, too. Available in seven models, ranging from 10 amps to 100 amps in either 125/250 or 150/600 volts. Choose the model that fits your job. *Only* **$19.85**

AMPROBE DECA-TRAN

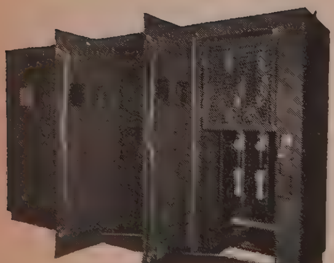
Makes your Amprobe the world's most flexible and versatile electrical test instrument. Extends amperage reading 10 times. Gets readings as high as 1200 amps. *Only* **$24.75**

AMPROBE ENERGIZER

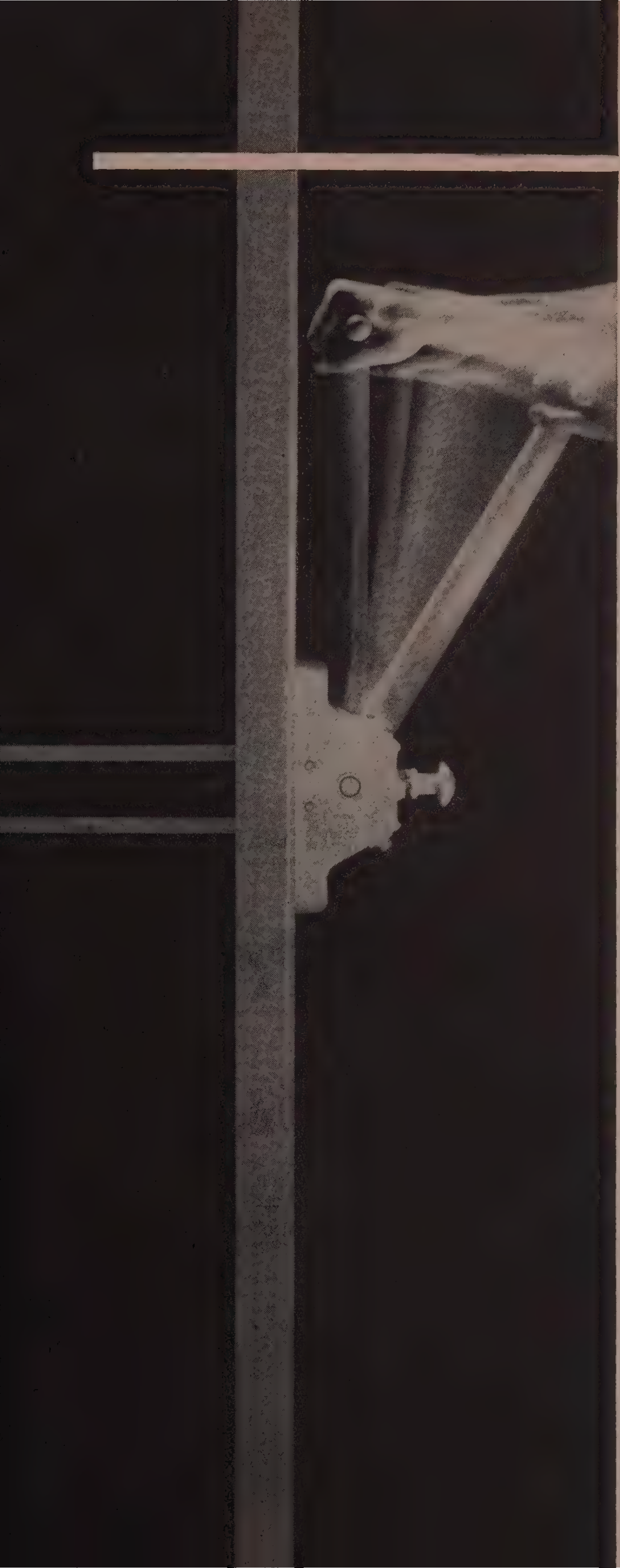
Multiplies the sensitivity of any Amprobe ten times—for precise readings on small appliances and fractional horsepower motors. *Only* **$3.75**

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, N. Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND VOLT-AMMETERS.

FAULT — CLOSING



S&C metalclad switchgear meets all requirements of new National Electric Code for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.



S&C metalclad switchgear can close on any fault up to 60,000 amps

No danger to equipment—no danger to operator even if he closes load interrupter switch on the heaviest faults. S&C's new line of metalclad switchgear is rated as high as 40,000 amps fault closing, 500 mva short-circuit interrupting at 14.4 kv. And at 4.16 kv, the corresponding ratings are 60,000 amps, 250 mva!

Here's how it works: 1) Fault never flows through interrupting unit when switch is closed . . . it flows through separate arcing contacts; 2) Arcing is minimized and magnetic forces are overcome by quick-make, quick-break toggle action no matter how slowly operator closes handle.

Short-circuit interrupting duty (up to 500 mva) is handled by a new boric acid power fuse, the Type SM, which features multiple bore construction to handle low, medium, and high faults.

The simplicity of the S&C design—power fuses for short-circuit interruption and load interrupters for manual or automatic load switching—enables you to save as much as 50 percent on your switchgear investment. Why not consider S&C Metalclad Switchgear for your high voltage power systems? In industrial plants and commercial and institutional buildings there are rarely any transient faults, so there is no real need for the automatic reclosing ability of the more expensive circuit breaker type of switchgear.

For more information please consult the telephone directory for your nearest S&C sales office.

S & C ELECTRIC COMPANY
4433 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1910

S&C

"By installing BERMICO CONDUIT at breakneck speed, we kept project work moving on schedule"

WILLIAM McCABE, Vice-President
Lord Electric Co., Portland, Oregon

Under construction. Lloyd Center, Portland, Oregon, one of the nation's largest metropolitan business-shopping developments, costing an estimated $30,000,000. 20,000 KVA initial power requirement.

"PRIME CONTRACTS for the Lloyd Center were let four months before the electrical contract," pointed out Mr. McCabe, Vice-President and Manager of the Portland office of Lord Electric Co. "By the time we were awarded our contract — the site was ready for the electrical conduit, so we had to move fast.

"Fortunate for us, Bermico was specified. By installing Bermico Conduit at breakneck speed, we kept project work moving on schedule."

Bermico Conduit is a great boon to electrical engineers, contractors and utilities. It is lightweight, easy to handle, simple to cut and assemble. Each 8-foot length is precision engineered, with smooth inside bore to allow easy pull-through without abrasion. Bermico is made from cellulose fibre, impregnated with coal tar pitch. It is extremely resistant to acids, alkalies, heat, water and corrosion — and of high dielectric strength. Use Bermico on *your* next job.

Distributed by WESTINGHOUSE Electric Supply Company and Agent Jobbers. Offices in Principal Cities.

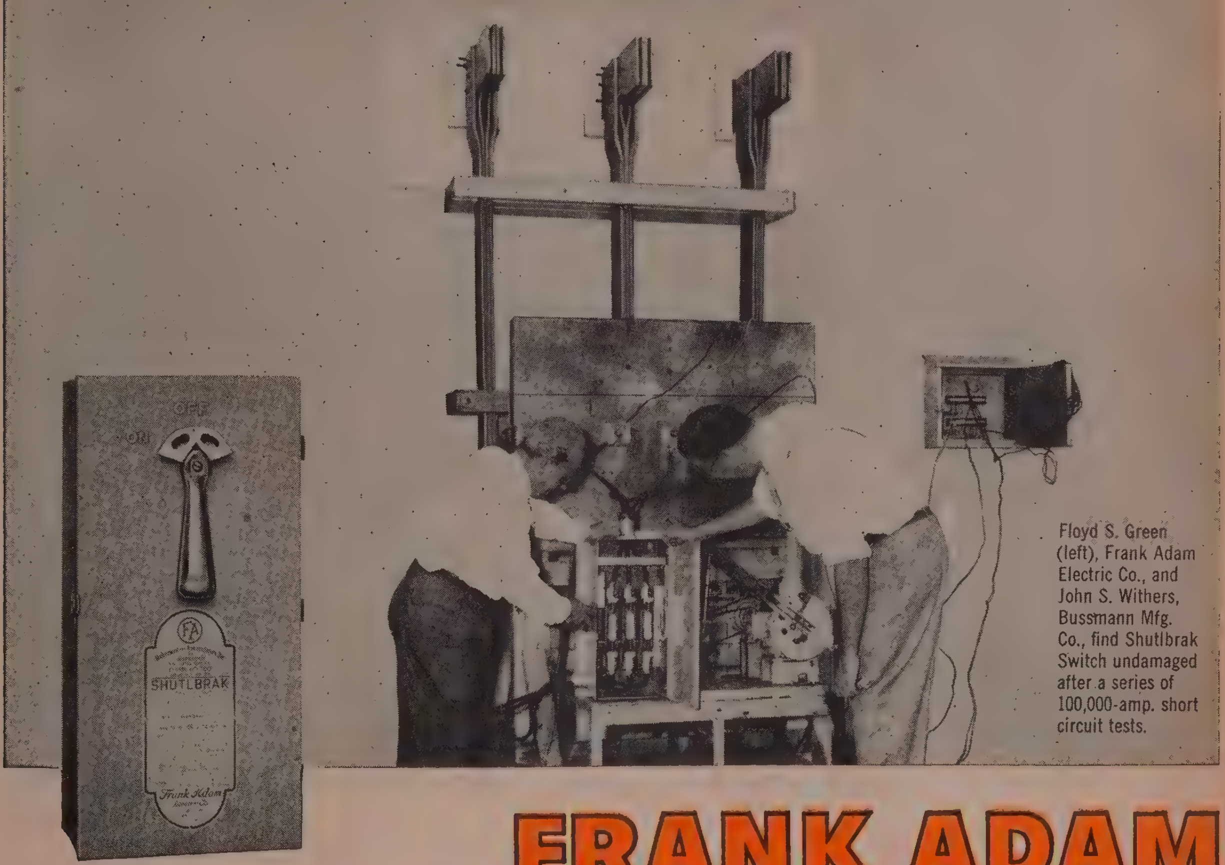
Another quality product of

BROWN QUALITY COMPANY

General Sales Office: 150 Causeway Street, Dept. **1530,** Boston 14, Mass.

Mills: Berlin, N. H.; Corvallis, Oregon

UNDAMAGED AFTER BEING "CLOSED" ON 100,000-AMPERE SHORT CIRCUIT!



Floyd S. Green (left), Frank Adam Electric Co., and John S. Withers, Bussmann Mfg. Co., find Shutlbrak Switch undamaged after a series of 100,000-amp. short circuit tests.

FRANK ADAM SHUTLBRAK SWITCHES

(SHUTTLE BREAK)

In recent tests at Bussmann Manufacturing Company's test station, Frank Adam Shutlbrak Switches, equipped with Bussmann high interrupting type fuses, went through a series of tests with switches "closed" on a 100,000-amp. short circuit. **NOT A SINGLE BREAKDOWN OCCURRED!**

Here's a powerful demonstration of the safety and dependability insured by Frank Adam's famous Shutlbrak mechanism. Ⓕ Safety Switches give positive protection to both men and equipment against every hazard that might be caused by the tremendous overloads and shorts that can occur in any distribution and feeder circuit.

It costs no more for the extra *vital margin of safety* provided by Frank Adam Switches. Specify this better equipment. A new brochure is just off the press—*write for yours!*

TYPICAL TESTS MADE WITH Ⓕ 3-POLE SHUTLBRAK SWITCHES

Switch Capacity	Fuse Type
100-amp. 250-v.	KTN Limitron
Same switch	LPN Low Peak
200-amp. 250-v.	KTN Limitron
Same switch	LPN Low Peak
100-amp. 600-v.	KTS Limitron
Same switch	LPS Low Peak
200-amp. 600-v.	KTS Limitron
Same switch	LPS Low Peak
400-amp. 250-v.	LPN Low Peak
600-amp. 250-v.	LPN Low Peak

See our catalog in SWEET'S

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P. O. BOX 357, MAIN P. O. • ST. LOUIS 66, MO.

busduct • panelboards • switchboards • service equipment • safety switches • load centers • Quikheter

THE PRODUCERS' COUNCIL
AFFILIATED WITH THE AMERICAN INSTITUTE OF ARCHITECTS

OPTIC NERVE FOR EYES THAT SEE 100 FEET BELOW THE SURFACE

This is a television camera. Its job is to photograph the substrata of excavations, thereby providing information needed by engineers in planning the construction of Boston's new Prudential Center, a modern, multi-million dollar real estate development.

Here in the Back Bay section of Boston, with its artificially maintained water table, this sealed camera must go down into a water-filled hole 100 feet below the surface. To transmit the picture from the camera to the surface monitor, Lake Service Corp. of Brighton, Massachusetts, designers and manufacturers of the television equipment, chose Simplex Anhydrex XX insulated cable because of its ability to withstand the rigors of submarine and direct burial duty.

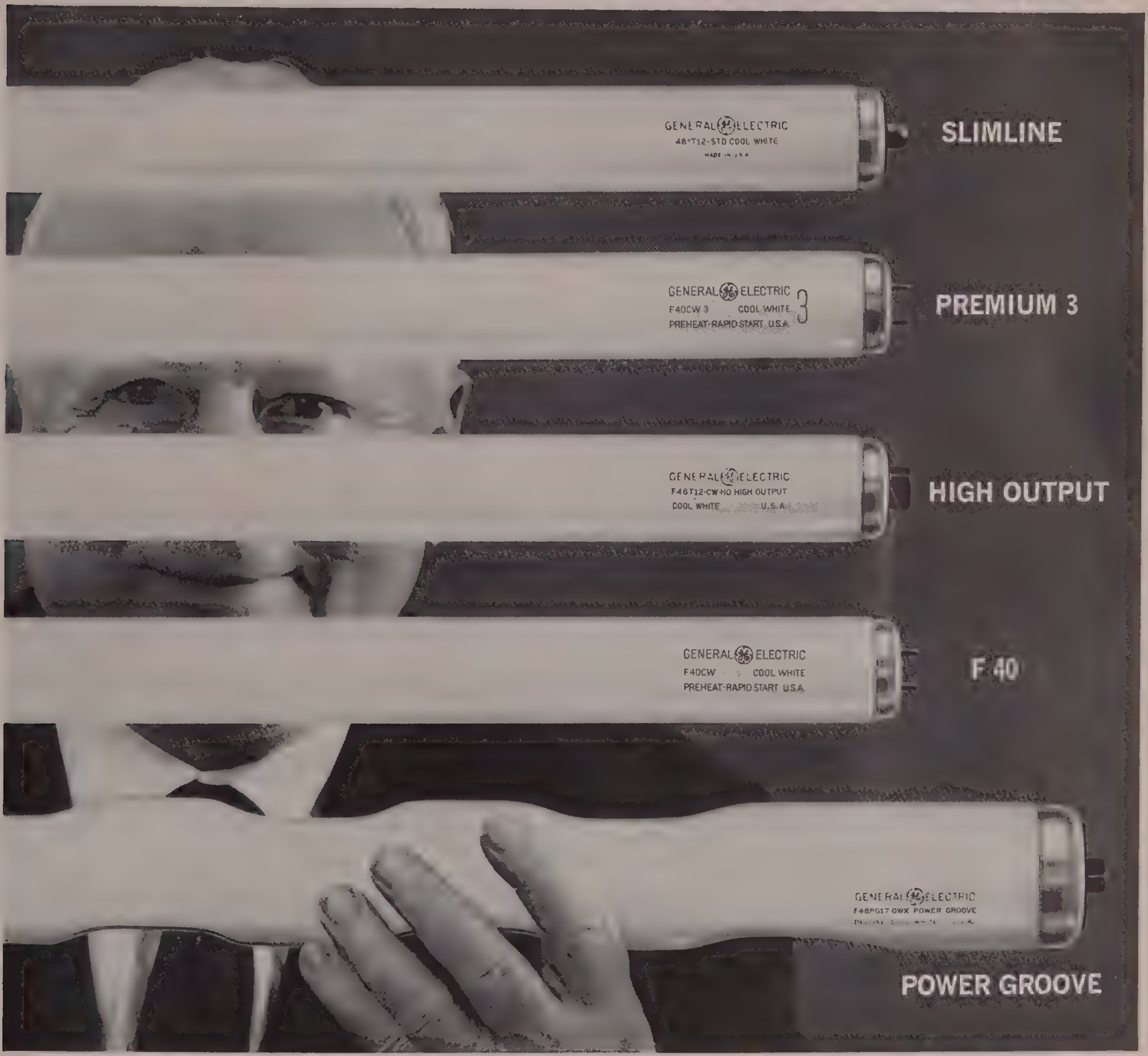
For all types of service involving high and low voltages, whether aerial, underground or submarine, or for everyday plant wiring, it pays to call a Simplex Engineer.

BALANCED COMPOUNDING

1885 Diamond Jubilee 1960
75 Years of Leadership in the
Wire and Cable Industry

Simplex
WIRE & CABLE CO.
Cambridge, Mass. • Newington, N. H.

General Electric Fluorescent Lamps
SAVE YOUR CUSTOMERS MONEY



Take initial cost for example:

NEW G-E POWER GROOVE LAMPS CAN SAVE CUSTOMERS $15 TO $85 PER LAMP!

General Electric's Power Groove* Lamp is the most powerful, most popular high intensity fluorescent you can buy. Because it *delivers* more light, users can have brighter plants, offices, stores, even outdoor lighting *while using fewer lamps and fixtures.*

Thus they can save, on initial cost, $15 to $85 per lamp over previous fluorescent types, depending on the installation. It's all because of the grooves in the tube which bend the arc stream and lengthen it to create extra light.

G-E Power Groove Lamps are a product of the same General Electric Lamp research that has improved *every* G-E Fluorescent Lamp—whether it's the slimline, high output, or one of General Electric's two new 40-watt lamps.

WHICH G-E MONEY SAVER LAMP IS THE BEST BUY? There's one that will solve any lighting problem. And General Electric's published record of performance leadership is your assurance that, if they use G-E Lamps exclusively, your customers' lighting systems stay up-to-date automatically. For more information call your G-E Lamp supplier or write: General Electric Co., Large Lamp Dept. C-010, Nela Park, Cleveland 12, Ohio.

*General Electric trademark for its non-circular cross section fluorescent lamp

Progress Is Our Most Important Product

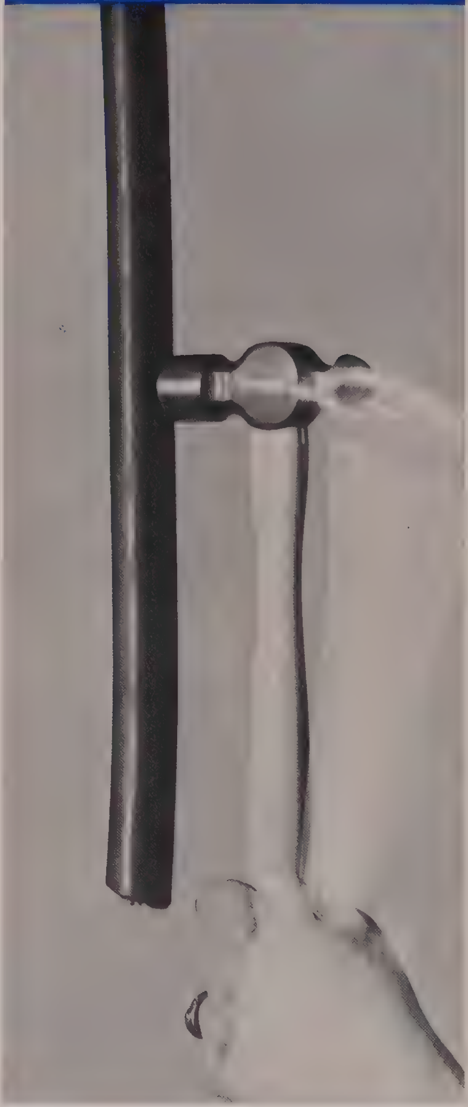
GENERAL ELECTRIC

General Electric . . . where bright ideas become better lamps

Neoprene resists COLD FLOW

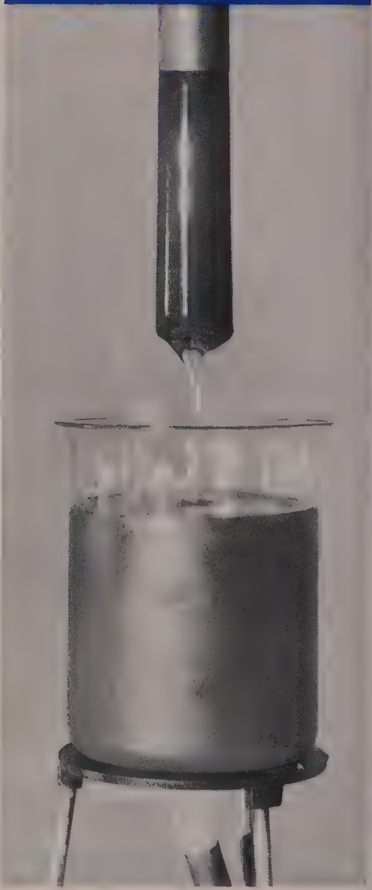
n laboratory tests and on the job, eoprene synthetic rubber has roved its ability to resist permaent deformation under load. It tays tough, resilient at high and ow temperatures. Other cable jacketing materials get brittle when old, soften when heated, flow when ompressed. Not neoprene.

Neoprene resists IMPACT



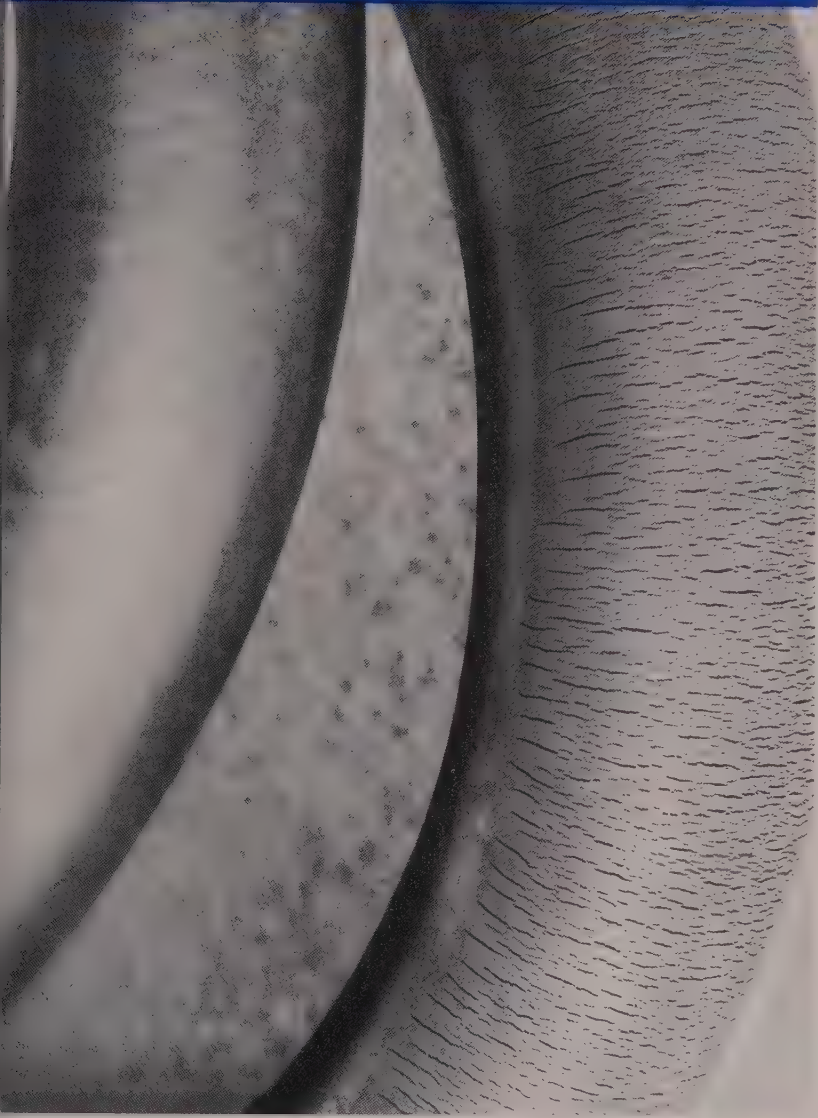
Neoprene is a tough, resilient jacketing that can take impact and abuse. In the most severe mining service it has proved its ability to withstand abrasion . . . to resist gouging and tearing. It surpasses other cable jacketing materials in laboratory impact tests. It gives your cable the best protection available against abuse.

Neoprene resists HEAT . . . OIL



Neoprene jacketing resists exposure to oil, grease and a variety of chemicals and solvents. Its resistance to heat protects insulation at temperatures as high as 250° F. In addition, neoprene is flame resistant; it will not support combustion, an important factor among safety-conscious cable users in factories, refineries and mines.

SUNLIGHT...WEATHER



nstalled January 6, 1935, these two test lengths of electrical cable have been exposed out of doors to rain, snow, sun, ozone and industrial fumes for over a quarter century. One jacketed with ordinary rubber (right) is badly cracked, furrowed, embrittled. But the neoprene jacket (left) is still sound, tough, resilient—still able to give complete protection to the cable.

PROVED

IN A QUARTER CENTURY OF INDUSTRIAL SERVICE —THERE'S NO DOUBT ABOUT NEOPRENE JACKETING

For more information, write to: E. I. du Pont de Nemours & Co. (Inc.),
Elastomer Chemicals Dept. EC-3, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

NEOPRENE
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

Neoprene resists SUB-ZERO COLD

In the arctic, neoprene synthetic rubbe
is used to protect radar domes—and yo
can use this cold weather durability i
cable that must serve outdoors in frigi
winter weather. Neoprene jacketing stay
flexible and resilient at low temperature
. . . successfully meets specifications fo
military cable designed for use at –65°

McGILL®

Levolier®

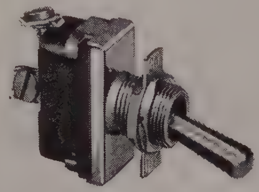
electrical specialties are

BUILT BETTER

to LAST LONGER

UNCONDITIONALLY GUARANTEED

The McGill No. 41 Levolier switch is unconditionally guaranteed against failure in lighting circuits. 6 amp. "T" 125 V. 3 amp. 250 V.

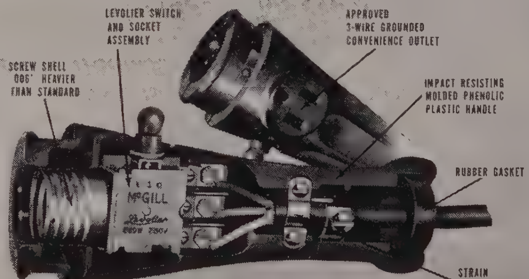


McGILL LEVOLIER SWITCHES

The same high standards of material selection and workmanship that make it possible for McGill to guarantee the No. 41 Levolier switch are applied to all McGill products. Levolier universal lever, toggle, momentary contact and special use switches from 3 to 20 amps have set performance records in a wide variety of uses. All are Underwriters' Laboratories, Inc. inspected.

McGILL PORTABLE LAMP GUARDS

McGill Lampguards are designed and built to withstand rugged industrial service. Top quality and careful workmanship assures a safe dependable light; where you want it, when you need it. Over 100 different types available including Grounded, Vapor Proof, and a variety of types of cages, handles and sizes.

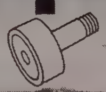

LEVOLIER SWITCH AND SOCKET ASSEMBLY
APPROVED 3-WIRE GROUNDED CONVENIENCE OUTLET
SCREW SHELL 006' HEAVIER THAN STANDARD
IMPACT RESISTING MOLDED PHENOLIC PLASTIC HANDLE
RUBBER GASKET
STRAIN RELIEF CLAMP

No. 5000 SLRG

WRITE FOR McGILL
ELECTRICAL SPECIALTIES
CATALOG NO. 84

engineered electrical products

McGILL®



precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

ALL NEW!

Now! A new "Super Tape" for cold weather and heavy-duty uses

"SCOTCH" Brand Electrical Tape No. 88 is an all new plastic electrical tape 20% thicker than ordinary plastic tapes. It was specially developed to be a "super" tape for the toughest jobs—is super conformable under all climatic conditions. Even in cold weather, the extremely stable plastic backing retains easy handling properties and feel; the high-tack adhesive sticks at a touch and grips firmly. And the extra-tough flame retardant backing provides excellent resistance to abrasion, puncture, flame, acids, alkalies, oil, and weathering. For complete information, just clip and mail the coupon.

Electrical Products Division

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF 3M CO., ST. PAUL 6, MINN. EXPORT: 99 PARK AVE., NEW YORK 17. CANADA: LONDON, ONTARIO.

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3M COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M Co., 900 Bush Ave.,
St. Paul 6, Minn., Dept. EAA-30

Please rush me complete information on your new cold-weather tape, "SCOTCH" Brand No. 88 Electrical Tape.

NAME______________________________

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ADDRESS____________________________

CITY_______________ZONE____STATE________

Another Engineering Achievement

INTERRUPTING CAPACITY: 100,000 RMS AMPERES

TIME-CONTROLLED AND INSTANTANEOUS PROTECTION

econ® DUAL ELEMENT CARTRIDGE FUSES

FASTEST CLEARING TIME . . . less than 1/4 cycle in all but highest ratings. DUAL CIRCUIT PROTECTION . . . Exclusive thermal-alloy element gives instantaneous action on short circuits. Cooler operating...low wattage loss. Timed delay eliminates nuisance blowing on harmless overloads...reduces replacement costs.

ETL CERTIFIED

Knife blade and cartridge types. 30-600 amperes; 250 and 600 volts—certified by Electrical Testing Laboratories to interrupt 100,000 RMS amperes.

FREE . . . Engineering Bulletin No. 1330; and handy fuse selector for motor protection. Get yours through your electrical distributor, or write: Economy Fuse Division, Federal Pacific Electric Company, Dept. 454, Chicago 14, Illinois—The Best in Electrical Control, Distribution and Power Equipment.

FPE

ECONOMY FUSE DIVISION CHICAGO, ILLINOIS
FEDERAL PACIFIC ELECTRIC COMPANY

They're built like circuit breakers! These new switches stand at the head of their class in safety switch design. Get top marks in circuit protection with all these PLUS features:

Instantaneous contact action	PLUS	Visible blades for safety
High current carrying ratings	PLUS	High current interrupting capacities
Low maintenance cost	PLUS	Low initial cost
De-ionizing arc chutes	PLUS	Silver alloy contacts
Fingertip operation	PLUS	Large handle—clearly visible "ON"-"OFF"

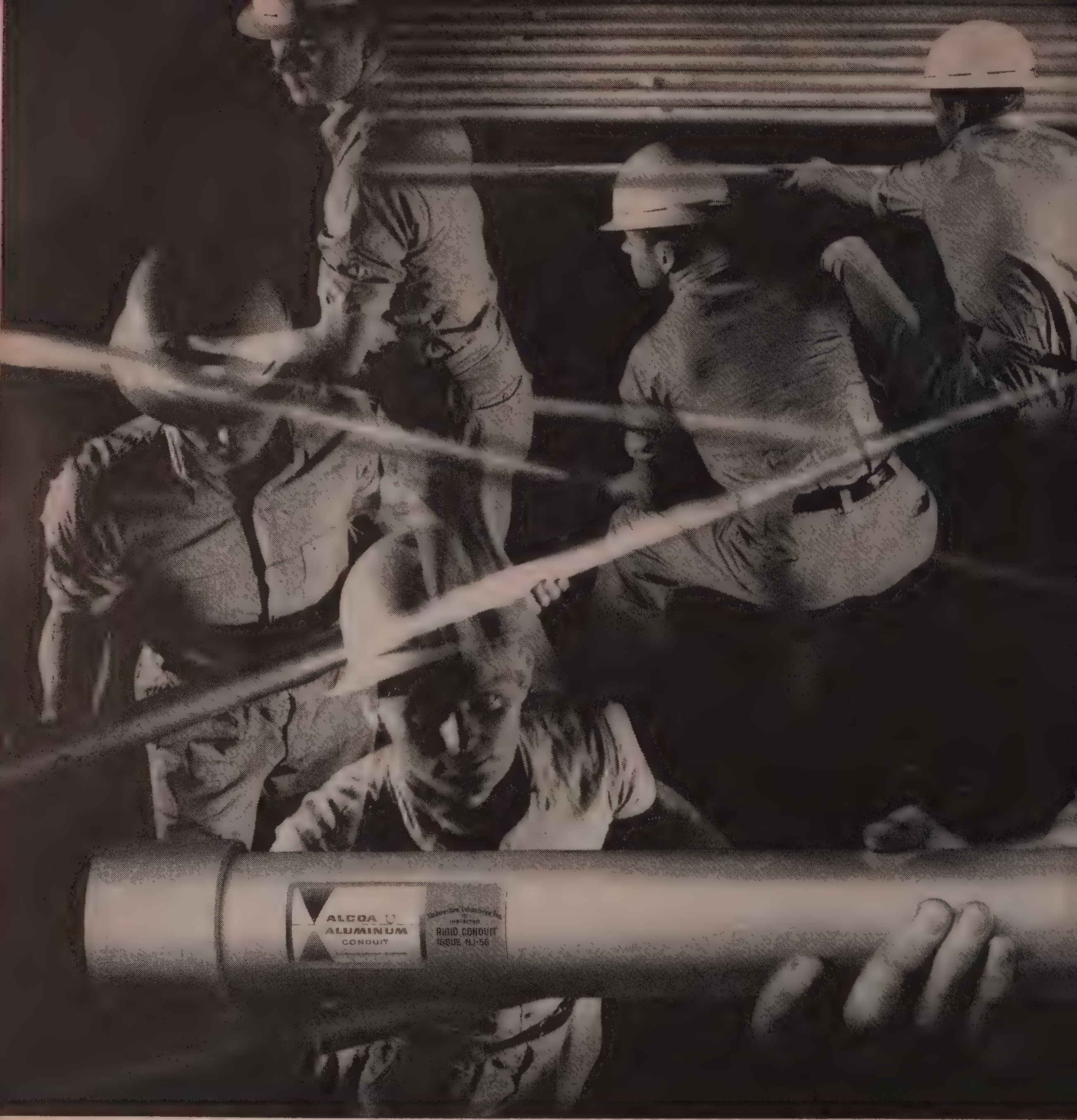
There's a complete line of safest, coolest, heavy-duty Type A Switches from 30a to 1200a. See your authorized FPE distributor or write for Bulletin #1240. Federal Pacific Electric Company, General Offices: Dept. 460, Newark 1, New Jersey —The Best in Electrical Control, Distribution and Power Equipment.

COMMON SENSE NEUTRAL BARS

All switches 30A thru 200A have solid neutral blocks installed at no charge. On switches 400A thru 1200A, the neutral assembly is separately packaged for installation when required.

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**

Affiliated with Cornell-Dubilier Electric Corporation



HERE'S WHY:

Light weight—weighs only ⅓ as much as steel . . . **easier to handle** regardless of the job . . . **easy to cut, bend and thread,** and without special tools . . . **competitive in price . . . nonsparking** for safer installations . . . no special nonsparking tools required . . . **corrosion resistance** means no maintenance under normal service conditions . . . **color coded** for fast, accurate size identification. **Approved by Underwriters' Laboratories, Inc.** . . . and it's **available from local distributor stocks** for fast, dependable delivery.

Aluminum conduit not only makes jobs go up easier, faster and therefore more profitably, but also helps you give your customers a higher quality, longer lasting installation. Why not use aluminum conduit on your next job? Start enjoying all the many advantages which only timesaving, costsaving aluminum conduit can provide. Your local Alcoa or Rome distributor can give you all the facts and figures for any particular installation. Or, write to Rome Cable Division of Alcoa, 2140-M Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA
ROME CABLE
DIVISION

ROME CABLE DIVISION OF **ALCOA**

Your Guide to the Best in Aluminum Value

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV

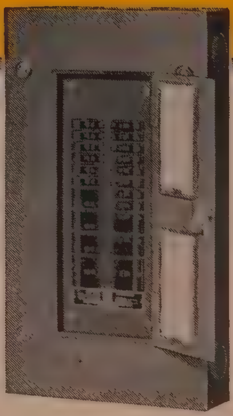
SAVE-
space
time
money

Same PANELBOARD LIGHTING AND

Heavy Duty Construction!

NQO
Panelboard

400 or 600 amp Mains



100 or 225 amp Mains

• Why waste time, space and money by installing separate lighting and power panelboards? Square D now makes it easy to combine 120 and 240 volt lighting and power loads up to 100 amperes, into one panel. Equally important, thanks to plug-in design and a complete range of circuit breakers (*see opposite page*), you can get a real heavy duty industrial type panelboard with exactly the circuits you need—right out of your Square D distributor's stock.*

*NBQ (plug-in) and NQOB (bolted connection) panelboards are also available factory-assembled for shipment direct to the job

SQUARE D COMPANY

COMBINES *Both* POWER LOADS!

FINEST BREAKER EVER BUILT!

THE QO FAMILY

. . . design leadership FEATURES

- Complete flexibility. Plug-in circuit breakers available up to 100 ampere three-pole in any arrangement.
- Distributed phase bussing—reads like a wiring diagram. Two and three-pole breakers may be mounted anywhere in the panelboard.
- Plenty of wiring room. 5" end gutters with 100 and 225 ampere mains; 8" end gutters with 400 and 600 ampere mains.
- Quality lugs throughout. Approved for aluminum or copper wire.
- Heavy duty enclosure. Galvanized steel boxes, full finished trim with a solid door.
- *Qwik-Open* feature of lighting breaker prevents damage due to high resistance or "arcing" faults.
- Ambient temperature compensation prevents nuisance tripping in high temperatures.
- Trip indication tells instantly whether circuit has been turned off intentionally or has "tripped."
- Temperature-compensated — prevents nuisance tripping.
- Common trip prevents single phasing or personal injury.
- Single handles on two and three-pole breakers for modern, streamlined appearance.
- Plated jaws and connectors assure positive connections.
- Heavy duty industrial quality for long life and trouble-free operation.

Write for the complete story
Address Square D Company, 1601 Mercer Road, Lexington, Kentucky

wherever electricity is distributed and controlled

Sports lighting requires a combination of short-range and long-range floodlights to provide good visibility for participants and spectators, and to add dramatic effect. Economical Revere Eliptor floodlights on Revere hinged poles illuminate this race track. Revere "2000" Series long-range, rear-serviced floodlights are mounted on the grandstand roof to increase intensity of illumination at the finish line.

Solve any outdoor lighting problem with Revere's complete, matched line

Peak lighting efficiency for any outdoor lighting application calls for a number of components, each designed to do a specific part of the job. Solving outdoor lighting problems is much easier when you install Revere equipment because—

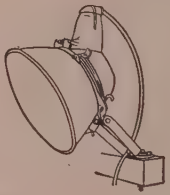
1. Revere offers the widest line, making it easy for you to select the exact combination of components to solve *any* outdoor lighting problem. Everything you need from one reliable source simplifies ordering, assures on-schedule delivery of all components.

2. Revere offers matched components . . . *structurally* matched for strength, balance, and perfect fit; *design* matched for peak lighting efficiency and best appearance.

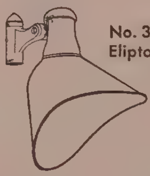
3. Revere offers easier installation—lights, poles and accessories are made for each other. Installation is fast, easy, trouble-free.

Write for Revere's catalog of outdoor lighting equipment. You can solve any outdoor lighting problem with this complete, matched line.

Revere components used to light race track



No. 2000 Series
Rear-Service
Floodlight



No. 3803
Eliptor Floodlight

No. 199-D-30
Hinged Pole

Revere ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
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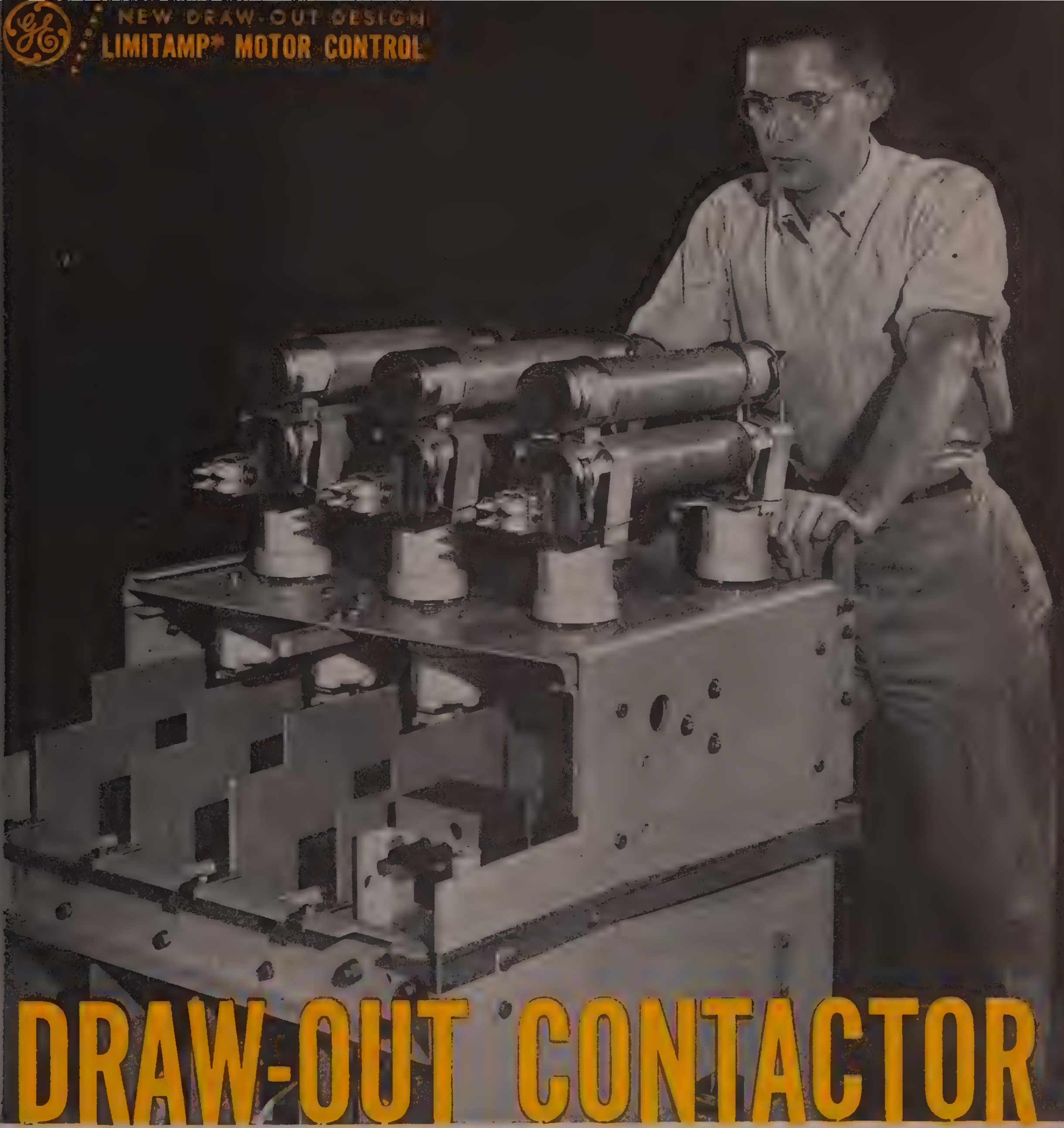

NEW DRAW-OUT DESIGN
LIMITAMP* MOTOR CONTROL

DRAW-OUT CONTACTOR

. . . cuts Limitamp control installation time

Rated 2300- to 4600-volts for a-c motors up to 3000 hp.

A draw-out contactor which automatically connects or disconnects as it is rolled in or out of the enclosure!

This is just one of the revolutionary design features in General Electric's new Limitamp motor control . . . a new design which cuts installation time in half!

During installation the contactor is easily withdrawn, leaving ample room to enter the enclosure, pull both motor and incoming power cables and make connections. When cables are connected, barriers are placed in position to seal off incoming line cable and a-c bus. The motor cable—located in its own raceway—is completely accessible when the starter is de-energized.

As the contactor is rolled back in, stab-on contacts automatically plug into the de-energized power circuit. At the same time, control power is automatically engaged. Installation time is held to a minimum.

Ask your G-E Apparatus Sales Engineer about other advanced-design installation, operation, performance and maintenance features of new Limitamp control. Or, write Sect. 783-11, General Electric Co., Schenectady, N. Y. for Bulletin GEA-6893. Industry Control Dept., Salem, Va.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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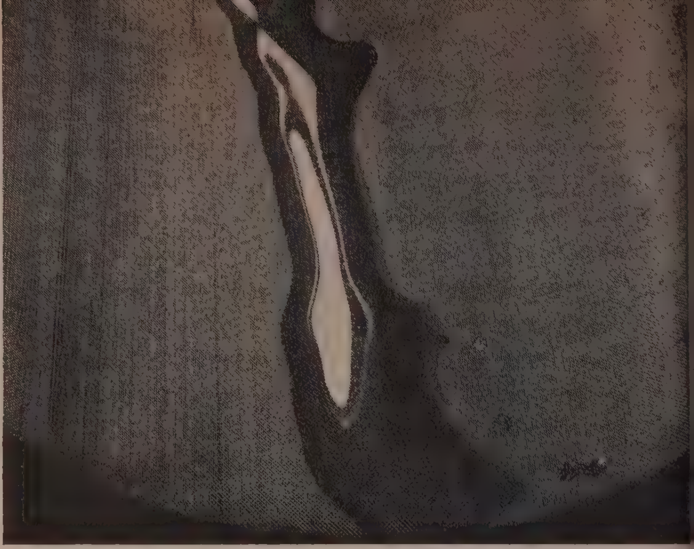
Above you see magnified sections of ordinary cable insulation (left) and Anaconda Butyl (AB) Cable insulation (right).



These screens, used in the extrusion head to entrap possible contaminants, ar so fine they actually hold water.

TWO BIG REASONS WHY ANACONDA BUTYL (AE

1. SPECIALIZED DEVELOPMENT

Because Anaconda was the first to develop butyl-insulated cable—and because butyl handles differently from other rubbers—many problems came up during development. Here are some examples—and how Anaconda engineers solved them.

A mixing problem: Like all raw rubbers, butyl in its raw state is a practically useless material. So it's mixed with specially selected additives and ingredients. Because it is very difficult to disperse these ingredients in butyl, Anaconda had to develop an entirely new mixing process and separate facilities to avoid contamination. Look at the comparison photos and see how successful it is.

A shielding problem: To eliminate laborious and time-consuming cleaning of insulation surfaces, Anaconda developed a semiconducting tape* which firmly adheres the insulation—and yet is easy to remove during splic and terminating.

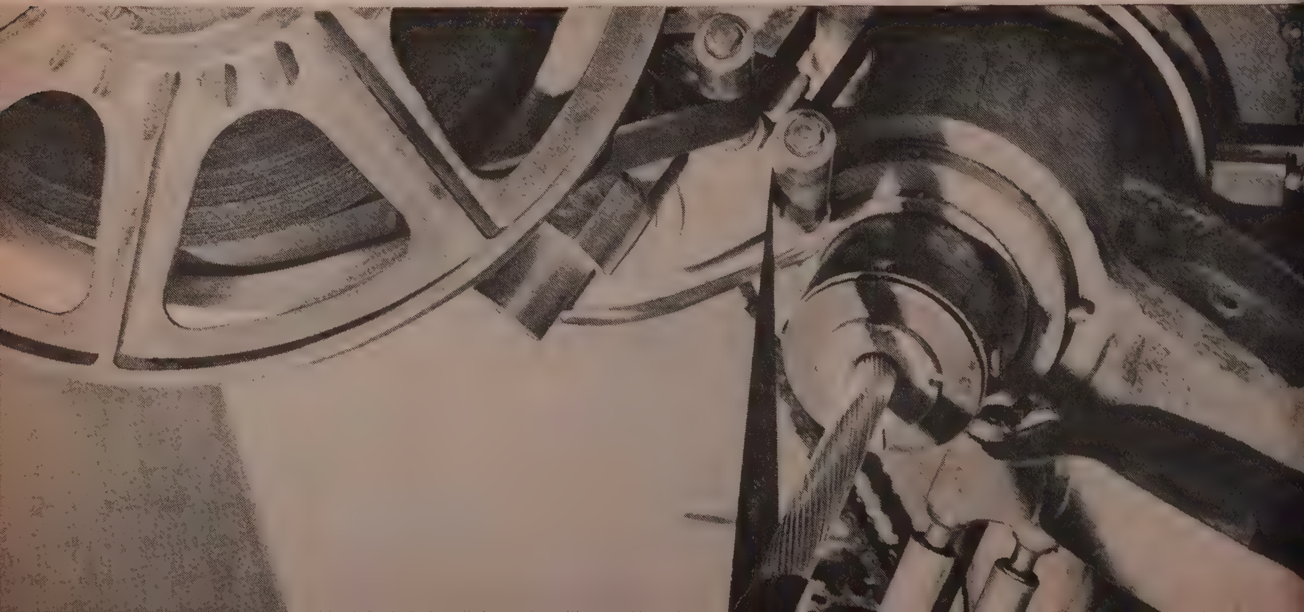
Even a vulcanizing problem: Ordinary vulcanizing equ ment might have a tendency to deform butyl insulation. Anaconda developed huge vulcanizing tanks which adı steam faster, vulcanize quicker and eliminate distortion

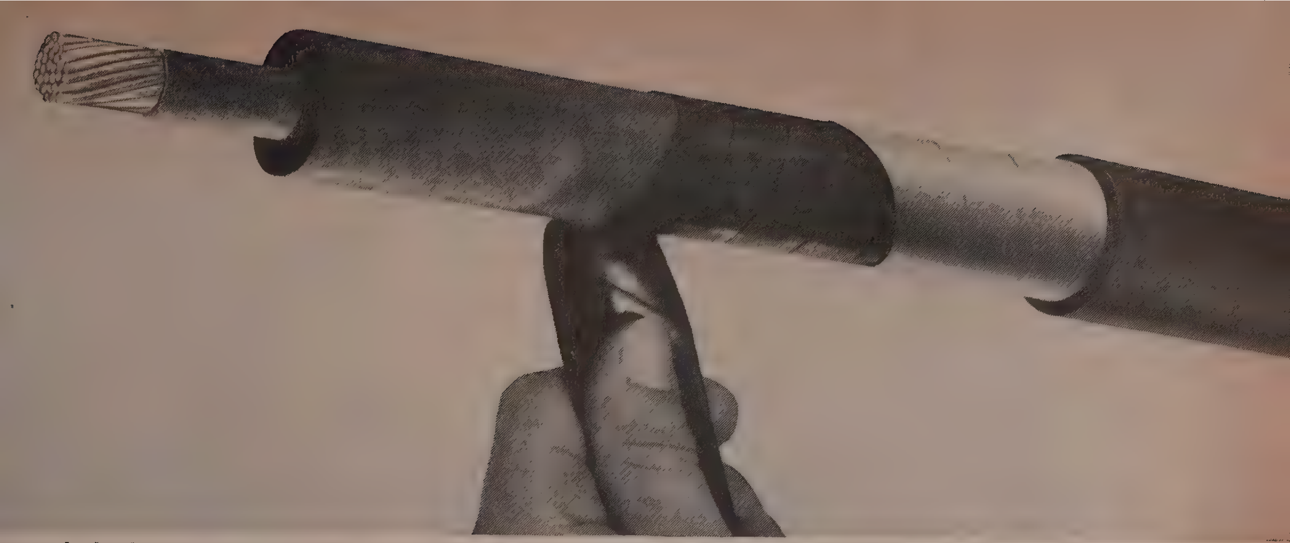
These few examples show you the types of proble Anaconda engineers were up against. Their solutions h show you why you can be sure Anaconda Butyl (AB) Cal is the finest cable you can buy.

2. SPECIALIZED MANUFACTURE

Anaconda's new Marion Mill was designed to handle o one product—Anaconda Butyl (AB) Cable.

Close-up of semiconducting strand-shielding tape being applied to 500-Mcm tinned copper conductor.





naconda development—semiconducting tape—adheres firmly to insulation, yet removes easily, facilitating splicing and terminating.

EANS RELIABLE HIGH-VOLTAGE CABLE

ne men behind this highly specialized equipment have
one job . . . to study and improve the design and manu-
ure of rubber-insulated high-voltage cable. Here are a
of the many places where they built precision right into
production line.

lation purity: For extra protection against contamina-
the unvulcanized Anaconda Butyl is passed through a
s of screens, one of which is so fine it will hold water.

nd-shield taping: For better equalization of internal
rical stress, Anaconda applies a special fine-mesh semi-
lucting tape under the insulation of all stranded high-
ge cables.

anizing in lead: Conventional lead presses must stop
odically for refilling—severely heating up and often
damaging the cable section in the die block, so Anaconda extrudes lead continuously. In the next step, exceptionally large drums are used for vulcanizing in lead to eliminate distortion of jackets and insulation.

These few examples help show you that the manufacture of Anaconda Butyl (AB) is highly specialized, highly precise—and why Anaconda offers you the big advantage of consistent high quality.

*Pat. applied for 60237A

ASK THE MAN FROM

ANACONDA®

ABOUT BUTYL (AB) HIGH-VOLTAGE CABLE

KEEP PACE ELECTRICALLY

e reel entering large vulcanizing tank which vulcanizes cable quicker than conventional methods, eliminating distortion of insulation.

These fluorescent lamps may look alike . . .

but only the Westinghouse Lamp has six

Despite similar appearance and ratings, these fluorescent lamps are *not* the same. One is a better lamp—and a better buy—because it's the only fluorescent lamp with all 6 advances described below. That lamp is made by Westinghouse. It costs you no more than any other leading brand—but it will give you years of trouble-free, efficient lighting.

1. MORE EFFICIENT PHOSPHORS—A special Westinghouse process selects Ultralume™ phosphor particles of a size proven to give more efficient lighting.

2. BRIGHTER END TO END—Lead wires are plated with super-hard Chrome Vanadium to make sure Westinghouse tubes *stay* bright, end to end.

3. BUILT-IN "SHOCK ABSORBERS"—Specially designed Westinghouse anodes act as buffers to cushion the terrific shock of electron bombardment and improve lamp life.

4. "RAINCOATS" FOR RELIABLE STARTING—Silicone "raincoats"

important advances that make it a better buy!

disperse moisture which can collect on exterior surfaces and prevent lamps from starting.

5. MIXED GASES—Westinghouse uses a precise mixture of certain rare gases, under exact pressure, to improve the light output.

6. TRIPLE-COILED ELECTRODES—To protect electrodes from the sudden electron bombardment when the lamp is first turned on. Emission material is quickly heated, fully protected.

Regardless of the type or wattage of fluorescent lamps you buy, you will get better value, more light for your money, and longer, trouble-free service if you specify and insist on Westinghouse fluorescent lamps. Westinghouse makes a complete line, from tiny 4-watt lamps for instrument lighting to the giant 96-inch Super-Hi™ Lamps for store, street, and factory lighting. Contact your authorized Westinghouse lamp agent or nearest Westinghouse sales office.

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WESTINGHOUSE LAMP DIVISION, Westinghouse Electric Corporation, Bloomfield, N. J.

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QUALITY SINCE 1896 *Makers of* SLIPKNOT FRICTION TAPE — *most widely used in the world* CANTON, MASSACHUSETTS

59TH YEAR • MARCH, 1960

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Electric Heat is the Key

Opening in Chicago this month, March 21 to 23, the first National Electric Home Heating Exhibition and Symposium marks the beginning of a new era of electrical development. Only a few years ago, such a meeting would have little more than academic interest to most electrical engineers and contractors. Today a practical understanding of electric space heating equipment and application technology is, or soon will be, essential to the conduct of their daily business.

Behind the swing to electric heat is a pattern of trends forcing a change in traditional attitudes. Summer electric utility system peaks, already common and for most systems inevitable, are upsetting long-established load criteria. Electric heat is a natural and logical seasonal complement to the climbing demands of summer cooling.

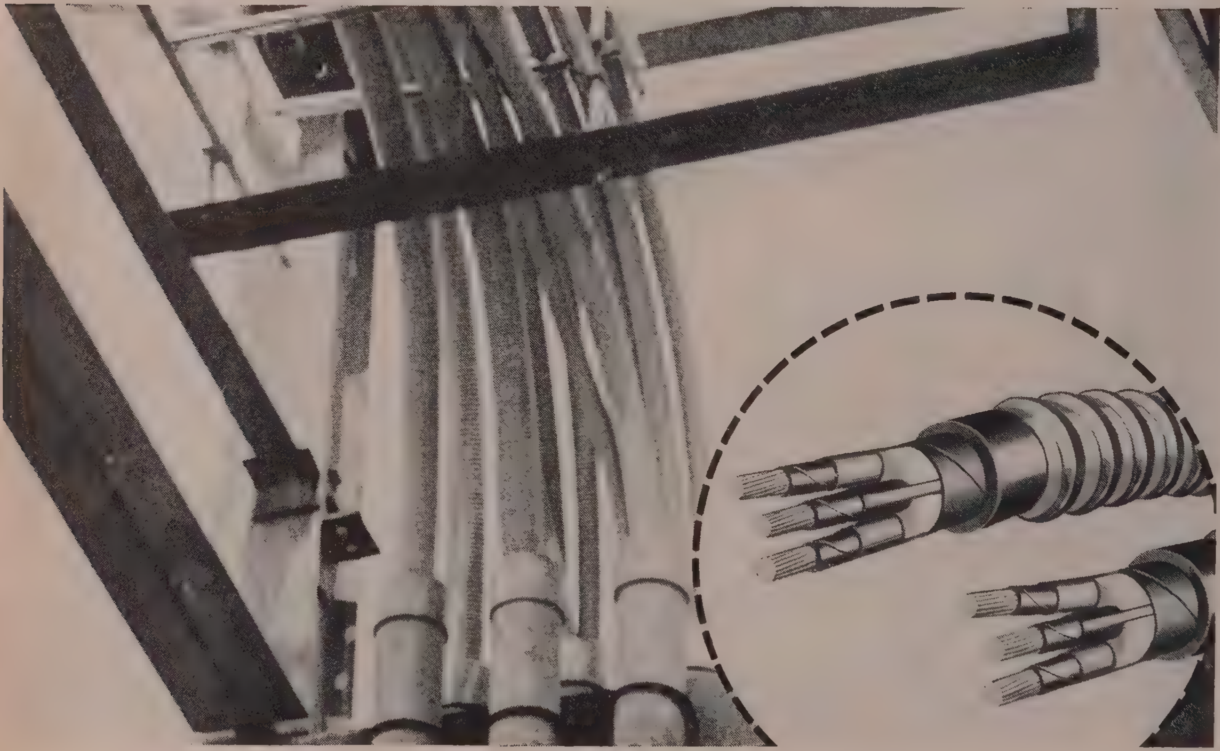
Balancing air conditioning load is only one part, however, of a much bigger issue—the battle for the consumer's energy dollar. The gas industry is going after it aggressively. If they can sell gas heat, they know they have a good chance to capture the refrigerator, range, water heater and dryer. They are not going to be content with only the heating service. They have a growing array of highly attractive major appliances to include in their package.

Heat is emerging, consequently, as the major key to the future of residential electrification. With electric heat, home equipment and appliances are entirely electric. High-capacity wiring is routine. Thus the all-electric Gold Medallion home presents an incontestable value in modern living. But any lesser objective leaves the door conveniently ajar for competing services.

Many electrical industry people still view electric heat as a fine prospect, but comfortably off in some indefinite future. Exposure to the fine programs scheduled in Chicago this month could provide them with a much needed education. The era of electric heat is already here. It is a vital component of the total service package that only the electrical industry can provide to the public.

Wm. T. Stuart

Goodyear uses NATIONAL ELECTRIC NEPCO-LOK in plants around the world



Thousands upon thousands of feet of Nepco-Lok Interlocked Armored Cable are installed in Goodyear plants from the Philippines to Scotland. Typical installation is found in the Goodyear Venezuela plant where more than 20,000 feet of various sizes has been installed for the primary and secondary power distribution systems.

Nepco-Lok Interlocked Armored Cable is the ideal material to use where there is danger of mechanical damage. It is easy to install and gives complete flexibility. If a line has to be replaced, Nepco-Lok is 100 percent salvageable.

For information, write: *National Electric Division, H. K. Porter Company, Inc., Porter Bldg., Pittsburgh 19, Pennsylvania.*

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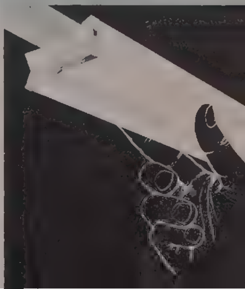

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ELECTRICAL
CONSTRUCTION
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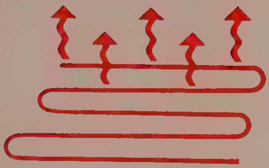


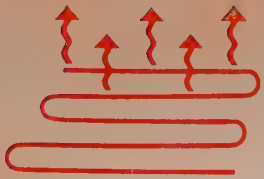
A Manual of ELECTRIC SPACE HEATING 1960

By W. J. Novak

A practical application and design reference covering

- heating equipment
- heat-loss calculations
- thermal insulation
- cost estimating
- electrical wiring

with complete tables of heat-loss factors, insulation curves, and climatic design data.



HEATING EQUIPMENT

ELECTRIC space heating today is accomplished either by resistance heaters or by heat pumps, in an approximate 7-or-8 to 1 ratio, respectively. In the former, heat is generated by the passage of electric current through the resistance afforded by copper conductors or other electrically conductive materials; heat pumps accomplish the exchange of heat from one medium, such as air or water, to the space to be heated, or from the space to be cooled to the air or water.

Resistance Heaters

Resistance heaters include wall units, floor furnaces, central furnaces, duct insert heaters, unit heaters, portables, insulated conductors embedded in the ceiling or floor, and ceiling units.

Wall units may be flush-mounted or recessed, incorporating a radiant glass or ceramic panel, heating coils, or other form of heating element, with or without a built-in fan.

Ceiling units, similar to wall panels, may include built-in fluorescent or incandescent lamps intended principally for use in baths. Infrared lamps are also used as the heat source for such applications; built-in fans for gentle circulation of the heat are usually available.

Floor furnaces, usually depending upon natural convection to distribute heat from the heating element, are recessed into the floor in a central location and are intended for comparatively small occupancies.

The central furnace is perhaps closest in operation to the fuel-fired furnace, resistance elements replacing the combustion chamber. The heat is distributed by means of blowers and ducts. More recent models have stepped controls to permit energizing successive sections of the heating element in accordance with the amount of heat needed. A modification of the central furnace distributes unheated air through the ducts, heating being accomplished by duct insert heaters located in the registers of each room. In either case, the same ducts may be used to distribute cooled air during the summer months from a central air conditioner.

Baseboard units, as their name implies, are installed along the base of the wall. Similar to wall units as to types of heating elements, these units provide a more distributed source of heat. Their relatively unrestricted length also permits a compact cross-section—roughly 2 by 7 in. Improved types contain automatic safety cut-offs which interrupt the current should any part of the baseboard be blocked, preventing the dissipation of the heat. The baseboard type is also available incorporating an enclosed recirculating hot water system, the heat being imparted first to the water and then to the space to be heated.

Heating cable is manufactured in standard lengths to produce a specified rate of heat when connected

Electric space heating—received initially as a curiosity, looked upon for years as an expensive luxury, and, as acceptance increased, described as the heat of the future—is today firmly established in some three-quarters of a million American homes and commercial and industrial structures not as a curiosity, not as a luxury, but as an economical and practical means of meeting modern heating requirements.

Initially developed and researched by the electrical industry, electric heat is generating interest throughout the heating field. Its exciting potentials, indicated by a variety of market, electric utility and user surveys, have been responsible for diversification of lines by established manufacturers to better satisfy the demands and preferences of a wider range of prospective customers.

Such diversification, plus constant product research by the leading manufacturers to better their existing equipment, has characterized the past year or two as a period of market growth and product improvement rather than as one introducing any radically new ideas or heating methods.

ELECTRIC HEATING INSTALLATIONS

(Complete Buildings)*

	As of Dec. 1 1957	As of June 30 1959	Estimated by Dec. 31 1959	Estimated by Dec. 31 1960
Resistance Heating				
Homes	261,000	548,000	579,000	654,500
Commercial and Industrial	29,000	33,000	34,250	37,650
Total	290,000	581,000	613,250	692,150
Heat Pumps**				
Homes	14,500	33,700	43,300	72,100
Commercial and Industrial	9,000	27,100	35,600	57,800
Total	23,500	60,800	78,900	129,900
Total, resistance heating plus heat pumps	313,500	641,800	692,150	822,050

* *Electrical World* surveys (Dec. 1959, 100 utilities reporting; June, 1959, 134 utilities reporting).

** Capacities of 2½ hp and up.

across its rated voltage. It is used embedded in ceiling plaster or between two layers of ceiling gypsum board, or within a concrete floor slab. It comprises the most widely distributed heat source, since it is installed in closely spaced rows over all unobstructed ceiling or floor areas.

Unit heaters, used chiefly for spot heating of industrial or commercial areas, use a relatively strong fan or blower to force air through a heating element configuration and into the space to be heated. Louvers are usually provided for direction control. A distinctive form of the unit heater of comparatively recent development is frequently called the schoolroom heater-ventilator, although its use has not been restricted to schools. Its flexible operation permits cool outdoor air to be drawn in and directed through heating elements by a blower to the space to be heated; or, with the heating elements deenergized, the cool outdoor air may be used to ventilate when cooling rather than heating is required. An indoor intake permits warm air to be mixed with the cool air in various proportions before passing through the heating coils.

Infrared radiant heating is finding increased use where more complete heating is unnecessary or uneconomical. Typical examples are a bowling alley, where units heat the spectators only, heating not being needed over the alleys; and sidewalk areas adjacent to store show windows, intended to keep prospective shoppers comfortable. Quartz lamps, having a very high output in the infrared region, are becoming popular as the heat source for such applications.

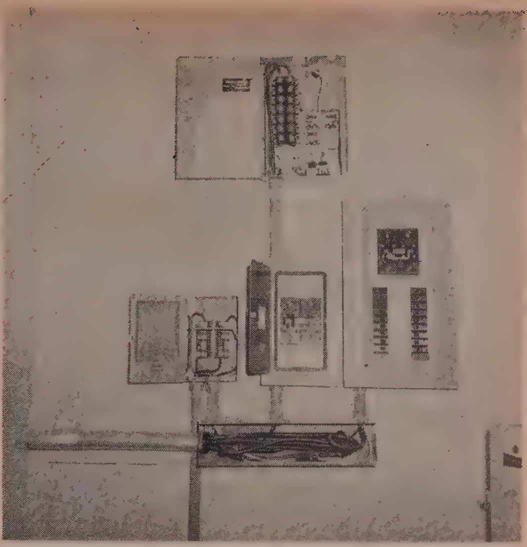
Heat Pumps

Heat pumps operate on a "reverse cycle" principle; they extract heat from a space during the warm season, and by either a manual or automatic switching operation, introduce heat into the space during cold weather, extracting heat from either the air, water or ground.

Units using water as a source of heat are practical where well water or stream, river or lake water substantially above the freezing temperature is available. Heat drawn from the ground by means of water pumped through embedded pipes is of relatively constant temperature, but the installation is expensive and sufficient ground area is not always available for laying the pipes. Also, available heat varies with shifting soil conditions.

Units drawing heat from the air are most widely used, since air is always available. The disadvantage here is that large equipment capacities are necessary in areas where air temperatures drop substantially below 20F, since a larger volume of air must be handled to extract sufficient heat. Recent developments using compound compressors (two compressors in series) have made operation practical down to −20F, but installed plant is extensive and not yet practical for small heating requirements.

Heat pump capacity is usually designed to handle the air conditoning load. When outside temperatures become too low for the installed capacity to handle heating loads, supplementary resistance heaters are usually provided for additional heat. Small room heat pumps developed in the past few years permit room-by-room control not practical with central systems.



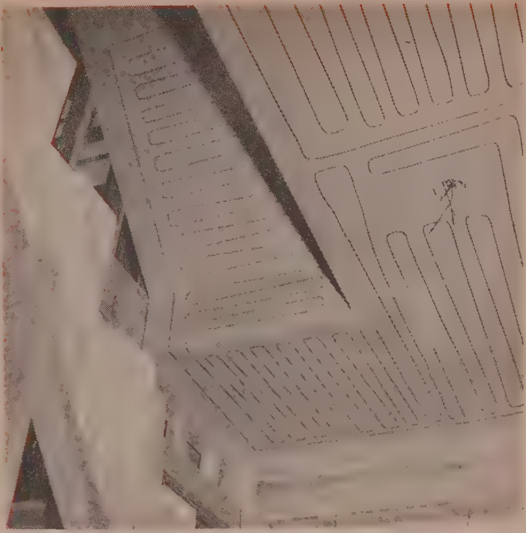
ELECTRIC SERVICE and distribution equipment on garage wall for a 5-ton residential heat-pump installation includes protective devices (top panel) for supplementary heaters installed in duct and, directly beneath, a 100-amp pullout for these heaters. In this installation, both heat pump and auxiliary heaters were located in the crawl space.

Blast-type duct heaters such as used on this job, usually including several elements energized one at a time as heat is required, must be approved for the purpose with proper protective equipment provided for each element, since build-up of heat in duct can lead to hazardous conditions. Extra depth of crawl space should be provided for such installations to insure sufficient safe working room for maintenance and servicing of equipment, with all controls located remotely as shown above. Lower left-hand panel contains 60-amp safety switch for heat pump; right-hand panel includes 100-amp pullout for lighting and appliance circuits. Service conductors are two 4/0 and one No. 2 RH-RW.

Although higher in initial cost and maintenance costs than resistance heaters, heat pumps offer the advantage of lower overall operating costs due to the "free heat" extracted from the external source. In addition, the total costs of both heating and cooling are often not a great deal more than heating alone with any other system.

Application and Installation

Heating equipment is located so as to replace most effectively the heat lost to the outdoors and to eliminate as far as possible any cold surfaces to which body heat can radiate. Wall panels and baseboard heaters are therefore placed on outside walls, preferably beneath window areas. In this position, they can effectively raise the temperature of the wall and inside glass surfaces. Convection currents set up within the room tend to move downward across the cooler window surfaces, combining with infiltrating air to produce a constant downdraft across the glass. Heat rising from units beneath the window helps neutralize this downdraft and prevents the cool air from circulating through the room. Locating the units at the baseboard or lower portion of the walls helps warm cool floors, while the natural rise of heat keeps ceilings warm.



CEILING CABLE configuration on first layer of gypsum board in living room is continued up onto ceiling over stairway leading to second floor. Note clearance provided around ceiling lighting fixture. Usual practice is to allow 8 in. on all sides of outlet box.

NON-HEATING LEADS on both ends of ceiling cable are planned to end up near the thermostat location. Protected by loom, they are brought up into attic space, down through top wall plate into stud space, and down to thermostat box.

Ceilings heated with embedded cable radiate directly to the floor, thus creating comfortable temperature levels on both floor and ceiling as well as on all objects between. Walls are heated by direct radiation, by reradiation from furniture and other objects, and by natural convection of air within the room. Where large window areas are present, it may be desirable to provide additional capacity beneath the windows in the form of baseboard heaters or, where slab floors exist, a few runs of floor cable in the slab beneath the windows.

Floor warming is used more extensively in the United Kingdom than in this country; milder weather conditions (3000 to 4000 degree-days) and smaller design temperature differences (approximately 35 deg F) are contributing factors. However, low off-peak electric rates, where they exist, make floor warming worth considering in certain commercial or institutional applications because of the ability of a floor to retain its heat for a considerable period after power is shut off. In such cases the floor must have a relatively high thermal storage capability so that little operation is necessary other than in off-peak periods.

Experience in Great Britain has shown that consumption over a seven-month heating season approximates 1500 kwhrs per kw heat loss, based on established practice limiting floor surface temperatures to 75F with an average inside design temperature of 60 to 65F. Equivalent installations in this country for the same degree-days would expectedly show higher consumption, since we prefer higher floor temperatures (80 to 85F) and higher space temperatures (70F).

Choice of ceiling or floor systems over other types is influenced greatly by the extent of occupancy. Heated floors or ceilings are practical in residences and in other structures which are occupied throughout the working day. Due to the time and energy required to bring the floor or ceiling to working temperature, it would be costly to make such an installation where heating would be required only one or two days a week, such as in a church. Floor warming is finding increased usage to supplement other types of heating systems, such as for warming vestibules and entranceways and for increasing floor temperatures of kindergarten rooms in schools where much activity takes place on the floor.

Wiring

Wiring of resistance heating equipment presents no particular problems. Built-in terminals and wiring space are provided for connection to line or thermostat conductors. In most cases heaters are designed so that standard 60C conductors can be brought directly to the/heater. The most desirable room installation includes a single wall-mounted thermostat to control all heaters in the room, all heaters normally being fed by the same circuit. The branch circuit breaker or switch serves as heater disconnect, although the thermostat may serve this purpose if it contains an "off" position and breaks all ungrounded conductors.

Many local codes have been established to control heating installations. The National Electrical Code contains special provisions for fixed electric space heating in Art. 422, dealing principally with embedded cable. It requires wiring above heated ceilings and within thermal insulation to be not less than 2 in. above the heated ceiling and derated for an operating temperature of 50C. It is consequently advantageous to locate all wiring above the insulation. To avoid a similar derating requirement in walls, wiring should not be run directly behind wall panels or baseboard heaters.

Heating cable may not be installed in closet ceilings, over cabinets which extend to the ceiling, under walls or partitions, inside walls, or, except for a single run of cable, may not pass back and forth over partitions or walls which extend to the ceiling. This exception is generally interpreted to permit use of the same cable for heating, in addition to a main room, a small vestibule or room separated by a partition without a door; or a bathroom plus dressing room or hallway, both spaces controlled by the same thermostat.

Cable runs in plaster or between layers of gypsum board must be not less than 1½ in. center to center, must not exceed 2¾ watts per foot, and must be secured at least every 16 in. Cable in concrete slabs must be spaced at least 1 in. apart.

Local codes may impose further restrictions. It is customary, for example, to leave at least 8 in. of clearance between ceiling cable and lighting fixtures. Thus, fixtures must be marked off on ceiling before cable is laid. Cable is usually run parallel to joists, with slightly wider spacing between adjacent runs under joists (approximately 2½ in.) to provide sufficient space for nailing the lower layer of gypsum board where used and thus reduce danger of nailing into the cable.

Cable circuits should be planned to end up near the spot where the thermostat is to be placed, so that the two non-heating leads may be run down to the outlet box on which the thermostat is to be mounted. These non-heating leads (red for 230 volts, yellow for 115 volts) are protected by loom.

Heating cable in ceilings and floors must be installed in continuous lengths as supplied by the manufacturer. The length and type of metal alloy used as the conductor are designed to produce the rated output when operated at rated voltage; hence any modification of the length will change the output and affect cable life.

The voltage available at the terminals of resistance heating equipment is important to proper operation; undervoltage could be responsible for grossly undersizing installed capacity. Some contributing factors are pointed out in Fig. 39.

Heat pumps are treated as standard motor loads, with particular attention to those sections of the code pertaining to hermetic motors[12].

Control

Local control of temperature in each room is a big advantage of resistance heating equipment and room heat pumps; but particular attention must be given the thermostat location for optimum results. It should be mounted 5 ft or less from the floor on an inside wall to avoid the direct effect of lower-temperature outside walls. It should not receive the direct output of a heater, nor should it be in a position to be affected by drafts when doors are opened. Direct heat from lamps or appliances will cause erratic and inefficient operation.

Both line- and low-voltage thermostats are available, the latter operating in conjunction with a relay. Both perform satisfactorily, although more accuracy should be expected of the low-voltage type because of lower current-carrying requirements for contacts.

A single heater installed as a supplementary source of heat or to serve a specific function, such as heating an entranceway or vestibule, may use a built-in thermostat to sense the temperature in that particular spot. It is usually preferable to use a wall-mounted thermostat where several heaters are used to serve a room.

Floor heating systems are sometimes provided with floor thermostats for limiting floor temperature to avoid heat damage to floor finishes or where there is particular concern over discomfort produced by excessive floor temperatures. Where this is the only method of control, wide variations are likely to occur as outside temperature varies. Operation of room air thermostats in conjunction with floor limiting thermostats produce more satisfactory results. More commonly, room thermostats are used exclusively without regard to variations in floor temperature.

Some flexibility in the rate of control is lost in floor systems due to the thermal lag of the large heated floor mass. The relative importance of this point depends to some extent on the activity of the occupants. Where they are at rest or sedentary a good portion of the time, it may be advisable to make some provision for the use of convection units within the heated space to be used as needed.

CEILING CABLE approved for installation between two layers of gypsum board is required to be installed in mastic. Without the mastic, dead air between the cable runs acts as a reservoir for hot air, decreasing the system's efficiency and increasing the possibility of cable burnouts. The mastic also prevents "creeping" of the cable with expansion and contraction accompanying temperature changes. Laboratory tests on cable used without mastic have found properly spaced adjacent cable runs actually making contact with each other, producing a hot spot and subsequent burnout.

The plaster and sand mixture normally used as a mastic is a good conductor of heat and thus accelerates the dissipation of heat from the entire circumference of the cable. In addition, it improves the conductance from the cable to the gypsum board where the cable does not make direct contact; even in the most careful installations small irregularities in construction and material prevent perfect contact between the cable and both layers of gypsum board throughout the entire cable length.

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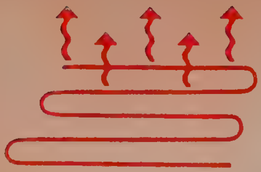
[12] *See references on last page of article* (*page* 124).



HEATING DESIGN

MANY short-cut methods of making heat-loss calculations have been devised and published. These methods may very well give approximately correct results, but they may also lead to disastrous results, depending upon the experience of the user and the types of structures involved. *There is no sure substitute for a knowledge of detailed calculations.* An experienced man applying time-saving methods to specific types of structures knows their limitations and is able to make adjustments. Applying stock formulas, charts and sliding rules indiscriminately can lead to undersized or oversized systems with a resultant mistrust on the part of the customer of both the contractor and electric heating in general.

It is hoped that the information presented here will provide a background of information and understanding for direct application to most heating jobs encountered or for further research and study.

Heat Loss

The amount of heat which is needed to maintain the desired temperature within a structure is equal to that which is lost by transmission through the floor, walls and ceiling and by infiltration through cracks around windows, doors, other openings, and between framing members. These two general types of loss may be termed *transmission heat loss* and *infiltration heat loss*. The former does not involve actual passage of air from the inside to the outside, as does the latter. Since a temperature difference exists through a wall, for example, heat is transmitted to the outside (1) by *conduction* due to the direct contact existing between building materials, (2) by *convection* due to any circulating air inside the stud spaces, and (3) by *radiation* across any existing air spaces in the wall or materials, regardless of how minute they may be. The transmitted heat loss will be directly proportional to the ability of the building materials to transmit heat, the time over which the heat is transmitted, the surface area considered, and the difference in temperature between the inside surface of the structure and the outside of the structure. There is also an additional small loss both inside and outside due to the difference in temperature between the surface of the building and the ambient air.

The first step in sizing heating equipment then is to determine as closely as possible the heat loss of the structure under the most severe conditions expected. This loss is expressed either in "Btu per hour per sq ft per degree difference in temperature between outdoors and indoors," or in "watts per sq ft per degree temperature difference." The latter units have been used quite extensively in electric heat work principally because equipment is rated in watts, and electrical men are perhaps more familiar with watts than Btu per hour. One may be converted to the other readily through the relationships

$$\text{watts} = \frac{\text{Btu/hr}}{3.413} = \text{Btu/hr} \times 0.293$$

$$\text{Btu} = \text{watts} \times 3.413.$$

Fig. 9 lists equivalent values of the two units.

The electrical man should understand both units to be fully conversant with other people in the heating business, the insulator, and the builder. Both terms will be used here, depending upon which can better express the point under discussion.

Note that "watts" incorporate the concept of time, hence "watts per hour" is incorrect and should never be used. Where it is necessary to relate watts to time in calculations to keep dimensions straight, it may be helpful to substitute "watt-hours per hour" for "watts." Thus both "watts" and "Btu per hour" designate the *rate* of heat loss, while "kilowatt-hours" and "Btu" designate a definite *quantity* of heat. The total heat loss over an entire heating season involves multiplying the rate of loss by the time period involved. This is discussed more fully under "Heating Costs."

The total heat loss requires that the following be known:

(1) the heat-loss factors of all building materials used;
(2) the floor, wall, ceiling, glass, and door areas and volume of all spaces to be heated;
(3) the temperature to be maintained indoors, commonly known as the "inside design temtemperature," "control temperature," or "control point";
(4) the coldest expected outdoor temperature with which the heating system is to cope, called the "outdoor design temperature"; and
(5) the amount and "heat-loss factor" of infiltrating cold air.

These points will be discussed in detail.

1. Heat-loss factors. Controlled tests have been made for all common building materials to determine their relative heat-transmitting ability, called *conductivity*, expressed in "Btu per hr per sq ft per deg temp diff per inch of thickness." This value, divided by the thickness, gives the *conductance* of the material of specified thickness, which is known as the *U-factor* or *heat-loss factor*. Thus the higher the U-factor, the greater will be the conductance, and the greater will be the rate of heat loss. Similarly, insulating materials have low U-factors, or high *resistance*. Resistance, as would be expected, is the reciprocal of conductance, expressed in "degrees F per Btu per hour sq ft," and is used to obtain the overall U-factors of complete building walls, ceilings, etc. Representative lists of heat-loss factors for common building constructions are given in Figs. 3 through 17.

2. Room area and volume. Since heat-loss factors are given "per square foot," it is necessary to multiply these factors by the wall, ceiling, floor or glass area to which they apply. Areas are obtained by direct measurement or from information on building plans. The room volume is commonly used in the evaluation of the amount of infiltrating air, hence the ceiling height must be obtained.

3. Inside design temperature. This is the temperature to which the thermostat is to be set. In this country, residential heating is usually designed assuming this value to be 70F.

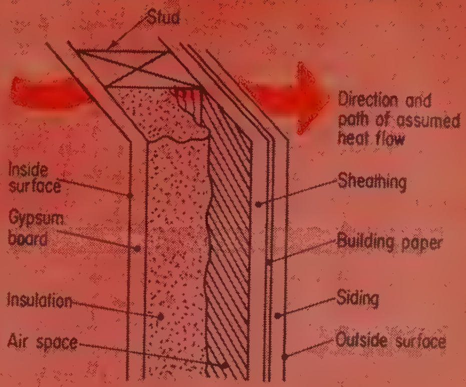
Departures from the 70F figure are often made for certain rooms of the house during design. Capacity is usually provided to maintain temperatures from 80 to 85F at design condition in bathrooms, basement playrooms, or rooms having large glass exposures. Higher bathroom temperatures are desirable since occupants will often be unclothed; basement playrooms do not get the benefit of solar heat or heat from appliances, etc., from the floor above. Large glass areas have a colder inner surface than the walls and promote loss of body heat by radiation; and the insulating effect of the air space in double-glass construction decreases with the increase in temperature difference across the air space.

Some areas are designed for temperatures lower than 70F. A heated garage need be designed for only 40F to eliminate freezing temperatures. Spaces where people are more active, such as industrial plants and bowling alleys, are designed for indoor temperatures as low as 55F, depending upon the activity involved.

4. Outside design temperature. A good deal of judgment is required to accurately anticipate the severity of a winter. It is impractical to attempt to install enough capacity to maintain heat based on lowest recorded temperatures for the area, since they are obviously infrequent and short-lived. A temperature 10 or 15 degrees higher than the lowest recorded has been the usual choice for this factor. The *1959 Guide* of the American Society of Heating, Refrigerating and Air Conditioning Engineers[7], long a standard for heating design data, lists several choices for the outside design temperature, based on the frequency with which each occurs in any given area. The temperature which occurs only once in 13 years is indicated as a conservative value for most uses, expecting that lower temperatures will be of short duration and that the heat storage capacity of the structure will prevent the indoor temperature from dropping to an uncomfortable level during such periods. These values are included in Fig. 38. Many designers feel that for well insulated electrically heated structures, higher values than those given may be used. Factors which must be considered in making this choice include the relative importance of an absolutely constant indoor temperature, significant local weather variations, conditions of occupancy, local wind conditions, and fluctuations of daily temperatures outdoors.

Subtracting the outdoor design temperature from the indoor design temperature gives the *design temperature difference.* It is important to understand that use of this design temperature difference in sizing heating equipment does not mean that the indoor temperature cannot be adjusted to higher values by the occupant. It does mean, however, that if the temperature outdoors were to remain at the outside design temperature for long periods,

FIG. 1. FUNDAMENTAL RELATIONSHIPS



The heat-loss factor of any building section depends upon the thermal resistance encountered by the heat in its passage from the inside to the outside. Just as the total electrical resistance of a series electrical circuit is the sum of the series resistances, so is the overall thermal resistance equal to the sum of the thermal resistances of each material making up the section. Thus for the wall shown in the illustration, the total resistance is made up of the individual resistances of the inside surface, the gypsum board, the insulation, the air space, the sheathing, building paper, siding, and outside surface. These resistances are given in the table. As shown, they add up to 11.37. Taking the reciprocal gives the U-factor of the wall, .088 Btu/hr/sq ft/deg TD.

It is evident from the figure that if the path of heat is assumed through the stud rather than between the studs, the total resistance will be different, the resistance of the stud taking the place of the resistance of the insulation and air space. Thus the overall U-factor of the wall, considering both paths of heat flow, will depend upon the relative areas to which each path applies. This is discussed more fully in the section on Framing Correction.

Wall element	Thermal values		
	Conductivity k	Conductance C	Resistance R
Inside surface	...	1.46	0.68
Gypsum board, ⅜ in.	1.16	3.10	0.32
Mineral wool insulation, 2 in.	0.27	0.135	7.40
Vertical air space, 1⅝ in.	...	0.87	0.97
Pine sheathing, 25/32 in.	0.80	1.02	0.98
Building paper	...	16.67	0.06
Wood siding, 1x8 in.	1.27	1.27	0.79
Outside surface	...	6.00	0.17
Total resistance			11.37
U-factor (Btu/hr/sq ft/deg F TD)			.088
U-factor (watts/sq ft/deg F TD)			.026

k = Btu/hr/sq ft/deg F TD/in.
C = Btu/hr/sq ft/deg F TD
R = deg F/Btu/hr/sq ft

$C=\frac{k}{t}$ where t = thickness in inches

$R=\frac{1}{C}$

$$\text{U-factor (Btu)} = \frac{1}{\text{Total resistance}}$$

$$\text{U-factor (watts)} = \frac{.293}{\text{Total resistance}}$$

FIG. 2 SUMMARY OF HEAT-LOSS FORMULAS

(1) Transmission loss = heat-loss factor × area × temp. diff.
(watts) (watts/sq ft/deg TD) (sq ft) (deg F)

(2) Infiltration loss = heat-loss factor × volume × temp. diff.
(watts) (watts/cu ft/deg TD) (cu ft) (deg F)

(3) Slab loss = heat-loss factor × perimeter × temp. diff.
(watts) (watts/ft/deg TD) (ft) (deg F)

For any one room, formula (1) is applied in turn to walls, floors, ceilings, windows and doors to give total transmission loss; formula (2) gives total infiltration loss for the room; formula (3) is used in place of (1) when floor is a concrete slab laid on or near the ground. The total room loss is the sum of the two formulas involved.

the heating system could not be expected to maintain a temperature indoors higher than the indoor design temperature (70F) for any length of time. At all other times, there is excess capacity which may be used to produce higher indoor temperatures.

5. **Infiltration.** Air leakage through cracks around windows and doors and through the building materials themselves is caused by differences in pressure inside and out due to the wind and to differences in air density. Any such air leaking in will be at outside temperature, and the heating system must have sufficient additional capacity to heat this air.

The tightness of the building will determine the amount of air leakage for any given orientation, type of structure, and wind speed. Obviously, the amount of leakage is difficult to assess, there being so many variables. It is common to assume for electric heating applications that the air in a residence changes completely once every hour through a combination of air leakage, doors and windows being opened, and artificial ventilation. Any special conditions changing this figure drastically should be taken into consideration (see Fig. 34).

Where all materials are closely fitted, insulation is carefully and tightly installed, all windows and doors are weather-stripped and protected with storm sash, and the house location and orientation is such so as to be subject to no extraordinary winds, the estimator may be perfectly justified in assuming only ½ air change per hour. On the other hand, combinations of large glass areas, no storm sash, vulnerability to wind, and careless construction could dictate use of two air changes per hour. Only experience in judging these conditions and a knowledge of the builder's workmanship can enable the heating man to pass accurate judgment.

Calculations

These five values having been determined, the next step is to calculate the overall heat loss of each space to be heated. The heat-loss factor for the walls, ceiling, floor, glass area, doors and infiltrating air must be substituted in the following formulas, the total loss being the sum of the two.

Transmission heat loss = heat-loss factor × area × design temp. diff.

Infiltration heat loss = heat-loss factor × volume × design temp. diff.

Results of these calculations should be entered in some type of estimate sheet. Most heating manufacturers supply such a form. Following this procedure on an orderly basis will eliminate errors of omission and by the simple use of a carbon, will provide a valuable record for future reference.

Special Considerations

Heated Ceilings

Some exceptions to this general procedure should be noted. Where heating cable is embedded in the ceiling, the temperature difference between the inside and outside surfaces is much greater than for an unheated ceiling, since ceiling temperatures at the design condition are in the neighborhood of 100 or 110F. The design temperature difference should be increased accordingly in calculating ceiling losses. Some heating designers prefer to consider temperatures for floor and ceiling other than the room temperature, due to the natural tendency of heat to rise. Thus for a conventional ceiling in a 70F room, a temperature of 75 or 80F may be assumed, with a floor temperature of 65F. The wall is figured at 70F, since the temperature averages out from floor to ceiling.

Closets

Closets are normally calculated as part of the room into which they open; room heaters will keep closet temperatures at a comfortable level. Where an open stairway to another heated room is built on an outside wall, the entire stairway heat loss should be included with that of the room in the main living area into which the stairway opens. This includes the total outside wall area and the ceiling above the stairway, if the space above the ceiling is unheated. If an unheated area such as a basement exists beneath the stairway,

Stairways

loss through treads and risers must also be included.

Heat loss through stairway to an unheated space should be divided among the rooms which the cold stairway walls face. Such walls, even though they are interior walls, must be insulated.

Window losses

Window heat losses are likely to vary with the type of heating system used, since the heat loss through glass is affected by the temperatures of room surfaces which radiate heat to the glass. Thus large glass areas exposed to a heated ceiling would conduct more heat than the same areas exposed to a room heated with baseboard units. A rigorous treatment of window losses would include a determination of the actual temperature of the inside glass surface. Assuming equal areas of 110F-heated-ceiling and 70F-unheated-wall facing a window, an indoor design temperature of approximately 90F rather than 70F would probably produce more realistic glass losses than the usual 70F. However, window drapes and shades where they are used tend to neutralize the effect of these temperatures, lowering the glass surface temperature.

Basements

Where basements are heated, basement heat loss is governed partly by the temperature of the earth, the existing frost level, and the proportion of wall above grade. Representative basement heat-loss factors are given in Figs. 13 and 14.

Floor losses

Floor heat loss calculations usually require special attention, depending upon the space below. Where there is a heated room or basement below, there is no floor heat loss, provided that the temperature of the space below is the same as that above the floor. If a basement is kept at say 40F solely to keep water pipes from freezing, a 30-degree temperature difference should be assumed and losses determined accordingly. If the basement is unheated, it is common practice to consider a 30- to 35-degree differential, although more accurate means for determing the unheated basement temperature have been proposed and should be considered[6]. Floor losses may exceed expectations in the fall and spring, when basal ground (or well-water) temperatures are lower than the outside temperature.

Crawl Spaces

The same considerations apply to tight, unventilated crawl spaces below the floor. Where the space is ventilated, outdoor temperature may be considered to exist beneath the floor.

Attics

Attics or attic spaces above ceilings should be well ventilated, hence outdoor temperature may also be assumed above the ceiling under such conditions. Precise calculations considering roof structure and size of ventilating spaces will usually result in a higher temperature, but use of outdoor temperature will be on the safe side without unduly exaggerating the losses (see Fig. 19).

Concrete Slabs

Heat loss through concrete slabs is affected both by earth temperature and by the outside temperature. Applicable heat-loss factors have been developed which, when multiplied by the *perimeter* of the slab and the design temperature difference, approximate the slab loss. These factors are given in Fig. 12. The formula to be used is thus

Slab heat loss (watts) = Heat-loss factor × slab perimeter × design TD

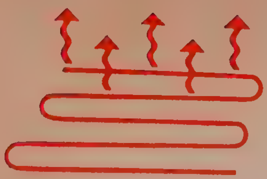
Halls

Where an outside door opens into a vestibule, foyer, or long hall, such a space is usually calculated as a room in itself, and heat is provided. Otherwise, hall losses may be added to those of adjacent rooms in sizing the capacity of these rooms, and no heater is placed in the hall. (An exception of course, occurs where a cable system is used, in which case all such spaces are heated.)

Selecting Heater Capacity

The sum of all heat losses for a given room will give the heater capacity required for the room. Manufacturers' literature should be consulted, and the rating of the heater type desired which most closely approximates the calculated heat loss should be chosen. If the rating available is reasonably close but lower than the calculated loss, it should not be cause for concern, since calculated loss is at the design condition, and no credit has been taken for the contribution of heat from lighting, appliances, etc. Also, small deficiencies in one room are likely to be counter-balanced by similar excesses in another room. (See Fig. 39 for effects of voltage.)

It is wise to consider several units of lower rating rather than a single-output heater where possible. The units may thus be separated to produce a more even and more comfortable heat distribution, usually at lower surface temperatures.



HEAT LOSS FACTORS

FIG. 3. FRAME FLOORS (Heat flow down)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Type of ceiling below joists*	Type of floor above joists Wood subfloor (25/32 in.) and felt plus			
	Cement (1½ in.) and ceramic tile (½ in.)	Hardwood floor (¾ in.)	Plywood (⅝ in.) and floor tile or linoleum (⅜ in.)	Insulating board (⅜ in.) and hardboard (¼ in.) and floor tile or linoleum (⅜ in.)
No ceiling below; bottom of joists exposed to basement or crawl space	.091	.082	.079	.072
Metal lath and plaster (¾ in.)	.064	.060	.058	.054
Gypsum board (⅜ in.)	.061	.057	.056	.052
Wood lath and plaster	.060	.056	.055	.051
Gypsum lath (⅜ in.) and plaster	.060	.056	.055	.051
Insulating board (½ in.)	.050	.047	.046	.043
Insulating board lath (½ in.) and plaster	.049	.046	.045	.043
Acoustical tile (¾ in.) on wood furring	.047	.045	.044	.041
Acoustical tile (¾ in.) on gypsum board (⅜ in.)	.045	.042	.041	.039

* Plaster assumed of sand-aggregate, ½-in. thick, unless otherwise specified.

To adjust these factors for insulation and framing, see Figs. 21, 22, 23 and 30.

FIG. 4. CONCRETE FLOORS (Heat flow down)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Concrete deck (inches)	Type of finish floor above slab	No finish ceiling; bare concrete slab	Ceiling applied directly to concrete slab			Ceiling suspended below slab						
			Plaster (⅛ in.)	Acoustical tile		Gypsum board (⅜ in.)		Metal lath and plaster (¾ in.)	Acoustical tile			
						Without plaster	With plaster (¾ in.)		On furring or channels		On gypsum board (⅜ in.)	
				½ in.	¾ in.				½ in.	¾ in.	½ in.	¾ in.
4 to 6	Bare slab; no finish floor above	.131	.130	.086	.073	.077	.075	.081	.064	.056	.059	.053
	Floor tile or linoleum (⅛ in.) or ceramic tile on terrazzo (1 in.)	.128	.127	.085	.072	.076	.075	.080	.062	.054	.058	.052
	Wood block (13/16 in.)	.098	.098	.071	.062	.065	.064	.068	.054	.049	.051	.047
	Wood subfloor (25/32 in.), felt and hardwood (¾ in.) on sleepers	.061	.061	.049	.045	.046	.045	.048	.041	.038	.039	.036
8 to 10	Bare slab; no finish floor above	.115	.114	.079	.068	.071	.070	.075	.058	.053	.056	.050
	Floor tile or linoleum (⅛ in.) or ceramic tile on terrazzo (1 in.)	.113	.112	.078	.067	.071	.069	.074	.058	.052	.055	.050
	Wood block (13/16 in.)	.089	.089	.066	.058	.061	.059	.063	.051	.048	.049	.044
	Wood subfloor (25/32 in.), felt and hardwood (¾ in.) on sleepers	.057	.057	.047	.043	.044	.043	.045	.039	.036	.037	.035

To adjust these factors for insulation, see Figs. 21 and 22.

FIG. 5. CONCRETE CEILINGS (Heat flow up)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Concrete deck (inches)	Type of finish floor above slab	No finish ceiling; bare concrete slab	Ceiling applied directly to concrete slab			Ceiling suspended below slab						
			Plaster (⅛ in.)	Acoustical tile		Gypsum board (⅜ in.)		Metal lath and plaster (¾ in.)	Acoustical tile			
						Without plaster	With plaster (¾ in.)		On furring or channels		On gypsum board (⅜ in.)	
				½ in.	¾ in.				½ in.	¾ in.	½ in.	¾ in.
4 to 6	Bare slab; no finish floor above	.181	.179	.104	.086	.105	.102	.113	.082	.069	.074	.064
	Floor tile or linoleum (⅛ in.) or ceramic tile on terrazzo (1 in.)	.175	.173	.102	.085	.103	.100	.110	.079	.068	.073	.064
	Wood block (13/16 in.)	.124	.123	.083	.071	.083	.081	.088	.067	.059	.062	.055
	Wood subfloor (25/32 in.), felt and hardwood (¾ in.) on sleepers	.070	.070	.056	.049	.055	.053	.057	.047	.043	.045	.041
8 to 10	Bare slab; no finish floor above	.151	.149	.094	.079	.094	.092	.100	.074	.064	.068	.060
	Floor tile or linoleum (⅛ in.) or ceramic tile on terrazzo (1 in.)	.147	.146	.092	.078	.093	.090	.099	.073	.064	.067	.060
	Wood block (13/16 in.)	.109	.108	.076	.066	.076	.074	.080	.062	.057	.058	.052
	Wood subfloor (25/32 in.), felt and hardwood (¾ in.) on sleepers	.065	.065	.052	.047	.052	.051	.054	.045	.041	.043	.039

To adjust these factors for insulation, see Figs. 21 and 22.

FIG. 6. FRAME CEILINGS (Heat flow up)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Type of ceiling below joists*	No floor above. Top of joists exposed to ventilated attic space	Type of floor above joists				
			Wood subfloor (25/32 in.) and felt plus			
		Wood subfloor only (25/32 in.)	Cement (1½ in.) and ceramic tile (½ in.)	Hardwood floor (¾ in.)	Plywood (⅝ in.) and floor tile or linoleum (⅛ in.	Insulating board (⅜ in.) and hardboard (¼ in.) and floor tile or linoleum (⅛ in.)
Metal lath and plaster (¾ in.)	.217	.092	.082	.075	.072	.066
Gypsum board (⅜ in.)	.190	.087	.078	.071	.069	.063
Wood lath and plaster	.181	.085	.076	.070	.068	.062
Gypsum lath (⅜ in.) and plaster	.180	.085	.076	.070	.068	.062
Insulating board (½ in.)	.111	.065	.060	.056	.055	.051
Insulating board lath (½ in.) and plaster	.107	.064	.059	.055	.054	.050
Acoustical tile (¾ in.) on furring	.098	.061	.056	.053	.051	.048
Acoustical tile (¾ in.) on gypsum board (⅜ in.)	.088	.057	.053	.050	.049	.046

* Plaster assumed of sand-aggregate, ½-in. thick, unless otherwise specified.
To adjust these factors for insulation and framing, see Figs. 21, 22, 24 and 31.

FIG. 7. FRAME WALLS (Heat flow outward)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Interior finish*	Exterior finish**														
	Wood siding, wood shingles, or wood panels					Wood shingles with insulated backer board or asphalt insulating siding					Brick veneer or plywood (⅜ in.)				
	Sheathing					Sheathing					Sheathing				
	Ply-wood	Gyp-sum board	Wood	Insulating board		Ply-wood	Gyp-sum board	Wood	Insulating board		Ply-wood	Gyp-sum board	Wood	Insulating board	
				½ in.	1 in.				½ in.	1 in.				½ in.	1 in.
Metal lath and plaster (¾ in.)	.092	.091	.077	.072	.061	.081	.080	.069	.065	.056	.105	.103	.086	.079	.066
Gypsum board (⅜ in.) or plywood (¼ in.)	.087	.086	.073	.069	.059	.075	.074	.064	.061	.053	.099	.097	.081	.076	.064
Wood lath or gypsum lath (⅜ in.) and plaster	.085	.084	.072	.067	.058	.073	.072	.063	.059	.052	.096	.094	.079	.074	.062
Wood panels (¾ in.)	.074	.073	.063	.060	.052	.065	.064	.057	.054	.047	.082	.080	.069	.065	.056
Insulating board lath (½ in.) and plaster	.064	.064	.056	.054	.047	.057	.057	.051	.049	.043	.071	.070	.061	.058	.050

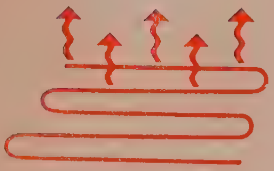
* Plaster assumed of sand-aggregate, ½-in. thick, unless otherwise specified.
** Sheathing details: Gypsum ½″; Plywood 5/16″; Wood 25/32″ plus building paper; Insulating Board 25/32″. Furring strips 1″ thick are assumed between wood shingles and gypsum, plywood and insulating board.
To adjust these factors for insulation and framing, see Figs. 21, 22, 25 and 29.

FIG. 8. MASONRY WALLS (Heat flow outward)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Interior finish*	Exterior finish																	
	Face brick (4 in.) or stone (4 in.) or precast concrete (4 to 6 in.) plus									Common brick (4 in.) or precast concrete (8 in.) plus								
	Concrete block backing			Hollow clay tile backing			Concrete backing			Concrete block backing			Hollow clay tile backing			Concrete backing		
	Thickness of backing (inches)									Thickness of backing (inches)								
	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12
Bare masonry wall; no interior finish	.143	.120	.112	.120	.092	.077	.177	.161	.148	.123	.106	.100	.106	.084	.071	.147	.137	.127
Plaster (⅝ in.) applied directly to masonry	.136	.115	.108	.115	.089	.075	.166	.152	.140	.117	.102	.096	.102	.081	.069	.140	.130	.121
Metal lath and plaster (¾ in.) on furring	.093	.083	.079	.083	.069	.060	.106	.100	.096	.084	.076	.073	.076	.064	.056	.095	091	.086
Gypsum lath (⅜ in.) on furring	.088	.079	.075	.079	.066	.058	.100	.095	.090	.080	.072	.070	.072	.061	.054	.090	.086	.082
Wood lath or gypsum lath (⅜ in.) and plaster on furring	.086	.077	.074	.077	.065	.057	.097	.092	.088	.078	.071	.068	.071	.060	.053	.087	.083	.080
Insulating board lath (½ in.) and plaster on furring	.065	.060	.058	.060	.052	.047	.071	.068	.066	.061	.056	.054	.056	.049	.044	.066	.064	.062

* Plaster assumed of sand-aggregate, ½-in. thick, unless otherwise specified.
To adjust these factors for insulation, see Figs. 21 and 22.



HEAT LOSS FACTORS

FIG. 9. HEAT LOSS CONVERSION TABLE

Btu per hr	Watts	Btu per hr	Watts	Btu per hr	Watts	Btu per hr	Watts	Btu per hr	Watts
.01	.0029	.21	.062	.41	.120	.61	.179	.81	.237
.02	.0059	.22	.064	.42	.123	.62	.182	.82	.240
.03	.0088	.23	.067	.43	.126	.63	.185	.83	.243
.04	.0117	.24	.070	.44	.129	.64	.188	.84	.246
.05	.0146	.25	.073	.45	.132	.65	.190	.85	.249
.06	.0176	.26	.076	.46	.135	.66	.193	.86	.252
.07	.0205	.27	.079	.47	.138	.67	.196	.87	.255
.08	.0234	.28	.082	.48	.141	.68	.199	.88	.258
.09	.0264	.29	.085	.49	.144	.69	.202	.89	.261
.10	.029	.30	.088	.50	.146	.70	.205	.90	.264
.11	.032	.31	.091	.51	.149	.71	.208	.91	.267
.12	.035	.32	.094	.52	.152	.72	.211	.92	.270
.13	.038	.33	.097	.53	.155	.73	.214	.93	.272
.14	.041	.34	.100	.54	.158	.74	.217	.94	.275
.15	.044	.35	.103	.55	.161	.75	.220	.95	.278
.16	.047	.36	.105	.56	.164	.76	.223	.96	.281
.17	.050	.37	.108	.57	.167	.77	.226	.97	.284
.18	.053	.38	.111	.58	.170	.78	.229	.98	.287
.19	.056	.39	.114	.59	.173	.79	.231	.99	.290
.20	.059	.40	.117	.60	.176	.80	.234	1.00	.293

FIG. 10. INFILTRATION

(Watts per cu ft per deg F temp diff)

½ air change per hr	1 air change per hr	2 air changes per hr
.0027	.0053	.0106

FIG. 11. HOLLOW GLASS BLOCKS

(Heat flow horizontal)

TRANSMISSION HEAT LOSS (watts per sq ft per deg F temp diff)

Nominal size (inches)	Undivided cavity	With glass fiber dividing cavity
6 x 6 x 4 thick	.176	——
8 x 8 x 4 thick	.165	.141
12 x 12 x 4 thick	.153	.129

FIG. 12. CONCRETE FLOOR SLABS*

(Unheated)

TRANSMISSION HEAT LOSS (Watts per ft of exposed edge)

Outdoor design temperature (deg F)	Edge insulation thickness (inches)**	
	1	2
−20 to −30	16	14.5
−10 to −20	14.5	13
0 to −10	13.5	12

* At or near grade level

** Insulation should extend 24 in. horizontally under slab; or 24 in. down along the foundation wall below slab level. See Fig. 18.

FIG. 13. BASEMENT WALLS AND FLOORS

(Below grade)*

TRANSMISSION HEAT LOSS** (Watts per sq ft)

Ground water temperature (deg F)	Walls	Floors
40	1.76	0.88
50	1.17	0.59
60	0.59	0.29

* Representative concrete or concrete block construction

** Based on 70F indoor design temperature

FIG. 14.

BASEMENT WALLS

(Above grade)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Wall thickness (in.)	Concrete (sand aggregate)	Concrete block (Three oval core)	
		Cinder aggregate	Sand and gravel aggregate
8	.197	.114	.150
10	.178	——	——
12	.162	.107	.138

FIG. 15.

SKYLIGHTS

(Heat flow up)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Type of sash	Single glass	Two sheets of glass		
		¼-in. air space	½-in. air space	1-in. or more air space
Large sheets of glass; no sash	.410	.205	.194	.185
Wood*	.370	.185	.174	.166
Steel*	.410	.206	.194	.185
Aluminum*	.451	.226	.212	.203

* 80% glass, 20% sash

FIG. 16

WINDOWS

(Heat flow horizontal)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Type of sash	Single glass	Unit-type double glazing**		Single glass with storm sash	
		¼-in. air space	½-in. air space	½-in. air space	1-in. or more air space
Large sheets; no sash	.331	.179	.161	.161	.155
Wood*	.299	.161	.153	.147	.141
Steel*	.331	.179	.194	.161	.155
Aluminum*	.365	.197	.210	.179	.170

* Windows assumed 80% glass, 20% sash

** Sealed units; two panes in same opening

FIG. 17

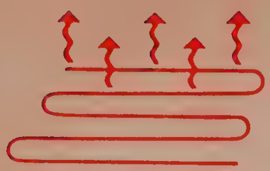
SOLID WOOD DOORS

(Heat flow outward)

TRANSMISSION HEAT LOSS (Watts per sq ft per deg F temp diff)

Door thickness (in.)		Exposed door	With glass storm door
Nominal	Actual		
Thin panel*	——	.249	.114
1	25/32	.188	.108
1 1/4	1 1/16	.161	.100
1 1/2	1 5/16	.144	.094
1 3/4	1 3/8	.141	.091
2	1 5/8	.126	.082
2 1/2	2 1/8	.105	.076
3	2 5/8	.091	.067

* Thin wood panel or single panes of glass



INSULATION AND MOISTURE

SINCE installed heating capacity and annual operating costs are both determined by the amount of heat lost from a structure, it is logical that available economical means of reducing the heat loss should be used. A check of the heat-loss formulas shows that the U-factor is the only element which the designer can reasonably expect to influence. From Fig. 1, it is evident that the U-factor may be reduced by creating additional thermal resistance between the inside and outside of the building section. This is usually done by means of fibrous insulation or reflective air spaces in the space created by the studs or joists.

Fibrous Insulation

Note in Fig. 1 that the 2 in. of insulation have the greatest resistance by far of all the wall elements, 7.40. Thus the resistance of 1 in. would be 3.70; and if the entire stud space were filled, the resistance would be 3⅝ x 3.70 or 13.4, quite an improvement over the resistance of 8.37 provided by the 2 in. plus the air space. Figs. 21 and 22 show the effect on U-factors of various insulation thicknesses.

Fibrous insulation, such as mineral wool, vermiculite, macerated paper, and wood and vegetable fiber, is manufactured either in self-contained blankets or batts or as loose fill. The thermal resistance provided per inch thickness by these materials varies from 2.08 to 4.00 deg F/Btu/hr/sq ft. Blankets and batts are made in thicknesses up to 6 in. and may be completely enclosed on three sides with a paper backing, a tough asphalt-coated draft paper covering the remaining side to act as a vapor barrier; or the paper backing may be omitted. Flanges extend from either side for stapling to studs. The term "blanket" originally applied to longer lengths which could be rolled up, "batts" designating 2-, 4- and 8-ft lengths. The two terms are now used more or less indiscriminately, however.

Loose fill is either applied by hand from bags or, more usually, by pneumatic blowing equipment. Thicknesses of insulation greater than 6 in. are normally installed in this manner, although thicknesses less than 6 in. may be. Where loose fill is used in walls, it is done pneumatically. Walls of existing homes are usually insulated in this manner.

Factors affecting the choice of fibrous materials include their thermal resistance, the effectiveness of the vapor barrier, whether they are fire- and moisture-resistant and vermin- and rodent-resistant, and the initial installed cost.

FIG. 18. SLAB INSULATION[8]

A. Thermal Properties

Type insulation	Thicknesses available (inches)	Thermal resistance per inch
Cellular glass enclosing sealed-in gas	2, 3, 4, 5	1.82 to 2.22
Glass fibers with plastic binder	¾, 1, 1½, 2	3.33 to 3.85
Cane or wood fiber board	½, 25/32, 1, and up	2.50 to 2.86
Hard cellular rubber enclosing sealed-in gas	½, ¾, 1, 1¼, 1½, 2	4.00 to 5.00

B. Design Temperature Adjustment

Outside design temperature, degrees F	Multiply resistance values in drawings by the following factors:	
	Unheated slabs	Heated slabs
−20	1.00	1.50
0	0.75	1.13
+20	0.50	0.75

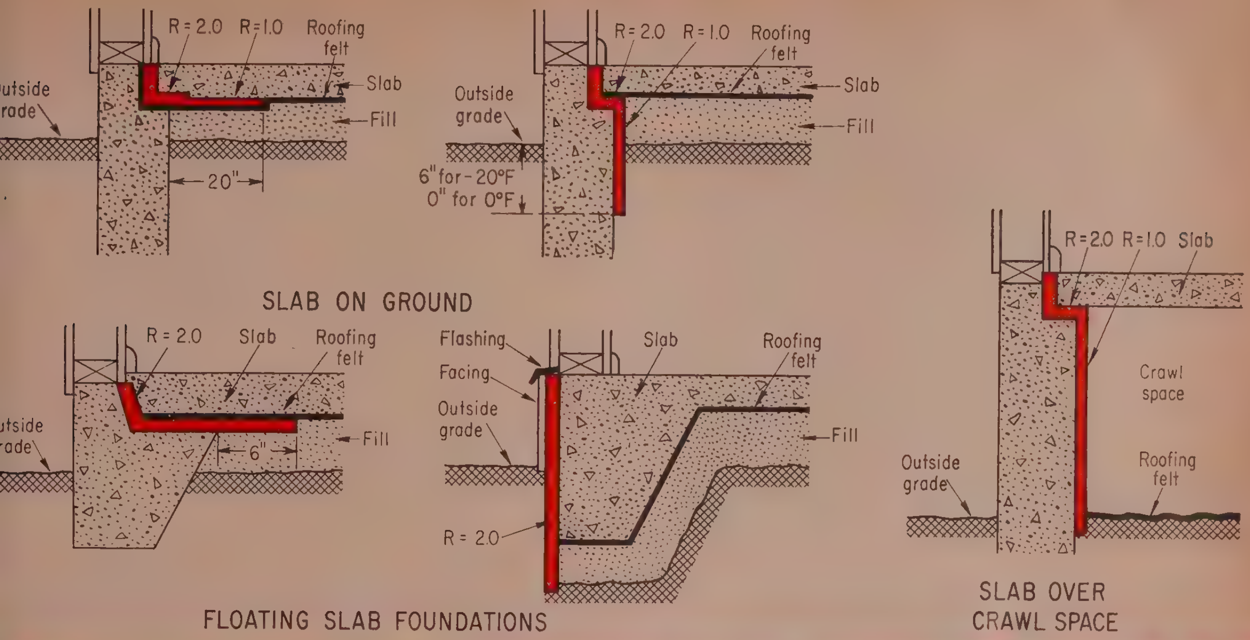
Reflective Insulation

Air is a relatively good insulator; since it is a mixture of gases, it does not permit conduction as readily as a solid. But its fluidity permits changes in pressure in a confined space, which, combined with temperature differences, creates convection currents that transmit heat. Heat is also radiated directly from surface to surface across an air space, the amount depending upon the temperature difference across the space, the thickness of the space, and the relative ability of the surfaces to reflect heat, called *reflectivity*.

The opposite of reflectivity is *emissivity*, which is a measure of the amount of heat which passes through a surface in a direction away from the source of heat. The most highly reflective surfaces thus have the lowest emissivities and therefore create conditions of highest thermal resistance when they are used in conjunction with an air space. The combined effect of two facing surfaces is designated by the *effective emissivity* of the space.

Refer again to Fig. 1. Note that the 1⅝-in. air space resistance is 0.97, approximately equal to that of the 25/32-in. wood siding. Ordinary building materials have a high emissivity, numerically equal to 0.82 as compared with the theoretical maximum of 1.0. Decreasing the emissivity of one of the two surfaces bounding the air space (the outer face of the insulation or the inner surface of the sheathing) would increase the thermal resistance value of the air space. This may be done by adding a reflective material, such as bright aluminum foil, to one of these surfaces. This would decrease the effective emissivity of the space from 0.82 to 0.05, with a resultant increase in resistance to the neighborhood of 2.6, this figure being influenced to a certain extent by the temperature difference. Adding aluminum foil

B. Representative Constructions (Resistance values shown are per inch for minimum comfort at —20F.)



to the other of the two surfaces would further reduce the emissivity to 0.03, not much of an improvement. Therefore economics will usually dictate against providing a second reflective surface facing the first, the net gain being insufficient to justify the cost.

Controlled tests have shown that the resistance of a reflective air space increases steadily as the thickness of the space increases to about ¾ in., and very slowly thereafter. Therefore in the example discussed above, the resistance of the air space would change insignificantly if the mineral wool were omitted and the air space increased to the full depth of the stud, or 3⅝ in.

The maximum thermal resistance that could be expected of this stud space, then (for a given temperature difference) would be around 2.6. However, the fact that a ¾-in. air space also produces a resistance of about 2.6 suggests that if the stud space were divided into several ¾-in. reflective air spaces, each would contribute a resistance of 2.6. Thus if a sheet of aluminum foil were positioned in the center of the stud space, two air spaces would be created, each having one reflective surface, producing a total resistance of 5.2. Four such spaces, created by three sheets of aluminum (or by two sheets of aluminum and a paper separator in between), would increase the resistance to 2.6 x 4 or approximately 10.4. A procedure for determining these resistances, taking space thickness, emissivity, and temperature difference into consideration, is outlined in Reference 11.

Reflective material suitable for such purposes is commercially available in collapsible assemblies with flanges which may be expanded and nailed to sides of the studs, multiple air spaces being created as the assembly is expanded.

The direction of heat flow has been found to affect the insulating value of air spaces, influenced chiefly by the amount of convection and conduction involved. Due to the tendency of heat to rise, air spaces in the floor provide the greatest resistance to winter heat loss. A single ¾-in. reflective air space of 0.05 effective emissivity under the same conditions of temperature difference as the above example would have a resistance of 1.84 located in the ceiling and 3.57 located in the floor. It would therefore seem that reflective insulation, as it is called, would find its greatest application for heating purposes installed in the floor, and such is the case.

Slab Insulation

As noted in the section on design, the greatest proportion of heat loss through concrete slab floors is from the edges, which are affected by the outdoor temperature, rather than from the interior of the slab, which is affected more by the higher ground temperature below the slab. Therefore, major effort should be directed toward reducing edge losses. This may be done using insulating materials such as are listed in Fig. 18A, installed in manner indicated.

Use of certain lightweight-aggregate concretes will also reduce heat loss down through the slab, but restriction of downward flow of heat will usually result in an increase in edge loss. Extending the insulation down vertically at the foundation forces the heat which is not restricted by the edge insulation to encounter considerable earth resistance in its path down through the ground beneath the slab, under the edge insulation, and up through the earth to the outside air. Extending the insulation horizontally under the slab raises the temperature of the floor surface close to the walls.

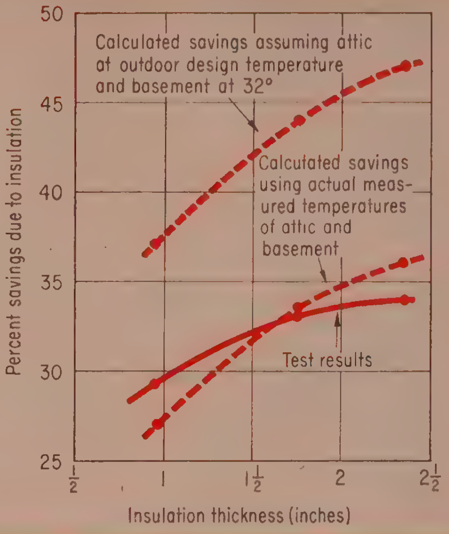
Some concrete slabs are laid over crawl spaces. Heat loss is likely to be greater in such cases because of the depth of foundation exposed to the outside air and the resulting lower temperatures under

FIG. 19. EFFECT OF OUTDOOR TEMPERATURE ON INSULATION SAVINGS

In estimating savings in operating costs due to installation of thermal insulation, care must be taken to use average outdoor temperatures rather than design temperatures. Use of design temperatures would give the heat-loss reduction if the design temperature existed throughout the heating season, which it does not.

Special attention should also be given attic, crawl space and basement temperatures in this respect. If the outdoor temperature is assumed to exist in a ventilated crawl space and attic, for example, the net reduction in heat loss for the ceiling and floor will be a greater percentage of the total loss than if more accurate temperatures were used; therefore the indicated savings due to insulation would be higher than would actually be realized.

The accompanying curves show such exaggerated results as revealed by measurements in four identical test houses.[9]



the slab; therefore insulation should line the entire inside surface of the foundation wall.

Resistance values indicated on the drawings of Fig. 18C are minimum for comfort at an outdoor design temperature of —20F. These values may be reduced for other design temperatures by applying the factors of Table 18B. Note that if embedded heating cable is used, these values should be increased.

Roofing felt is used to provide waterproofing to prevent wet cement from leaking into the fill before setting, and to protect the insulation from moisture in the soil.

Insulation is chosen on the basis of its insulating value, initial cost, structural strength, ability to withstand moisture, mildew, termites, etc., and ease of installation. Some may be made to adhere to the foundation; others may require keys or metal ties to hold them in place.

Economic Factors

Obviously, insulation is an effective means of increasing the thermal resistance of a building shell to reduce heat loss. Selection of interior and exterior finishes of higher resistances, such as insulating board lath and sheathing, will further reduce the loss; but where great thicknesses of insulation are used, such gains are negligible and hardly justifiable economically.

The degree to which a floor, wall or ceiling should be insulated from an economical standpoint cannot be stated arbitrarily. Each case must be judged individually, with all factors considered. For a residence, insulation is economically sound to the point that it reduces the cost of initial equipment and annual operating costs sufficiently to lower the sum of annual mortgage payments and electric heating bills. Further insulation may be chosen for the additional comfort it provides. Included in the insulating costs are storm windows and doors; no insulating job is complete unless means are taken to reduce the relatively large glass heat loss and discomfort accompanying radiation of body heat to cold glass and door surfaces. Storm sash and weatherproofing are also instrumental in reducing infiltration losses.

Cost considerations in the insulation of commercial or industrial structures must necessarily include factors different from those considered for residences, such as income taxes; hence the thickness of insulation which is economically feasible for one will not be the same for the other. Also, the many different construction methods used in commercial or industrial buildings affect the manner in which the insulation may be installed. The same thickness of insulation installed in two different ways in the ceiling or roof, for example, may produce two widely separated values of thermal resistance as well as radically different installed costs.[10]

Minimum insulation recommendations made by NEMA for electric heating and subsequently adopted by the FHA are shown in Fig. 20. Substantially, these resistances indicate 6 in. of mineral wool or equivalent in the ceiling, 3⅝ in. in the 2 by 4 wall stud space, and 2 in. the floor. However, successful installations are being made with 10 to 12 in. in the ceiling, 5⅝ in. in a 2 by 6 wall stud space, and 10 in. in the floor; and they have been shown to be economically sound through actual operating data. Figs. 26 and 27 point out important factors of analysis which are often overlooked in evaluating costs of greater insulation thicknesses.

One other important point: heat losses are calculated at design temperature conditions, whereas actual electrical consumption is determined at average conditions throughout the heating season. Evaluating savings in operating costs due to insulation, therefore, must be done on the basis of *average* temperature differences; otherwise exaggerated savings will be indicated. Some aspects of this question are explored in Fig. 19.

Moisture

Insulation does not cause moisture; however the tightness of most electrically heated structures can create moisture problems if care isn't taken to prevent them.

Generally, moisture can cause paint peeling and blistering on the outside of a building; wood rotting in attic spaces, crawl spaces and walls; damp walls within the house; and a disagreeable, musty smell throughout. The fundamental cause is the condensation of water vapor on cold surfaces—water vapor which is created within the building by cooking, bathing, washing clothes, etc.

Whether water vapor will condense and where it will happen depends upon the indoor and outdoor temperatures and the relative humidities indoors and out. If air and water vapor are cooled, the water vapor will condense out when a certain temperature is reached. This is called the *dew point;* the air is completely saturated with the vapor. There is a specific water vapor pressure associated with each dew point; for example, vapor exerting a pressure of 0.2 lb/sq in. will condense if it meets a surface at 54F, whereas if its pressure is only 0.1 lb/sq in., it won't condense until it is subjected to a temperature of 35F.

The more moisture present in a given space, the higher will be its vapor pressure (or humidity), and the higher will be the temperature at which condensation will take place. Assume the temperature of the inside surface of a window is 44F. Moisture will condense on the glass if its vapor pressure reaches 0.142 lb/sq in. However, if we raise the temperature of the glass to 50F through use of storm windows, the vapor pressure would have to increase to 0.178 lb/sq in. before condensation would take place.

Obviously, when moisture condenses, there is less vapor in the air, and the vapor pressure decreases. Therefore where storm windows are not used, moisture condensing on the glass, although a nuisance, relieves the pressure and reduces penetration through the walls, ceilings, etc.

Assume now that storm sash is in place, raising the inside glass temperature, and insulation is used in all walls, ceilings and floors, making those surfaces warmer. It will now take a great deal more moisture to raise the vapor pressure sufficiently to cause condensation at these higher temperatures.

But with increased pressure, the vapor is forced through porous wall, floor and ceiling materials and into the stud and joist spaces. If the inside temperature is 70F and outside 10F, somewhere between the inside and outside surfaces there exists a temperature equal to the dew point associated with the vapor pressure which has been established. It is at that point, then, that the moisture will condense. This process continued for a long period can cause large accumulations of moisture within a wall, for example, with consequent damage.

This can be avoided by the erection of a suitable *vapor barrier* on the inside of the wall to prevent the vapor migrating into the wall in the first place. Such barriers are incorporated as part of most fibrous insulation blankets and batts. Large, thin, plastic sheeting is also used extensively for this purpose, being fastened to the tops of floor joists before the floor is laid or to the inside wall stud faces before adding the wall finish. Where there is a well ventilated attic, vapor barriers are frequently omitted from ceilings.

In general, crawl spaces under insulated floors will usually require ventilation plus some type of roll roofing or plastic on the ground to hold down moisture from the earth. On the other hand, where climatic conditions are favorable and moisture problems unlikely, crawl spaces are often sealed to reduce floor heat loss. In some cases, it may be advantageous to seal a crawl space and provide dehumidifying equipment.

Naturally, if we prevent the vapor from passing through the walls, etc., it will stay inside and cause dripping water pipes and beverage glasses, fogged eyeglasses, and a general muggy atmosphere. Every such home, therefore, should have at least one exhaust fan to remove the moisture. Preferably, there should be a fan provided at each source of excessive moisture, such as the kitchen, the laundry area, and the bath. Again, dehumidifying equipment can be helpful where moisture can't be prevented or removed by other means.

It should be remembered, however, that moisture is objectionable only in excess. A certain amount is necessary for comfort and health. Relative humidities of 30 to 60% are conducive to a comfortable, healthful atmosphere; when the humidity drops to the neighborhood of 15%, respiratory disorders can be expected.

Outside air during the winter is lower in temperature and consequently carries less moisture than indoor air. Entering the house by infiltration, it must force out existing higher-humidity air if a net balance of pressure is to be maintained inside and out. Therefore the process of infiltration is constantly tending to lower the humidity indoors.

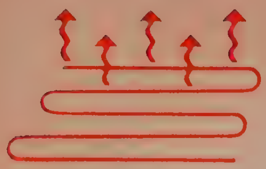
Electric heat, through elimination of the chimney and because of greater insulation thicknesses, thus effectively cuts infiltration and reduces the rate of loss of moisture. This is consistent with recurring reports from electric heat users crediting their relative freedom from colds to the heating system.

FIG. 20. INSULATION RECOMMENDATIONS

Following are NEMA[1] suggestions for maximum heat-loss factors for electrically heated homes under average conditions.

	Watts/sq ft/deg TD
Ceilings, unheated	0.021
Ceilings, heated	0.014
Walls	0.024
Floors over unheated basements	0.029
Floors over ventilated crawl spaces	0.021
Between floors of multi-story building	0.026

The amount of insulation required to meet these values may be found conveniently by using the curves of Figs. 21 through 25.



CORRECTION OF HEAT-LOSS FACTORS FOR FIBROUS INSULATION

THESE charts, used with values taken from Figs. 3 through 6, give the heat loss factors of walls, floors and ceilings with fibrous insulation (mineral wool or equivalent) added between framing members. The resultant factors should then be corrected for the effect of framing using Figs. 29 through 31.

Two sets of curves are given: one for constructions where the insulation only partially fills the space between framing members, leaving a resultant air space at least ¾ in. wide, and the other for constructions where the insulation completely fills the space. The latter curves compensate for the loss of the air space. (For ceilings without a floor on the top side of the joists and for floors without a ceiling on the underside of the joists, Fig. 21 should be used.)

Curves are based on insulation conductivities of .27 and .30 Btu per hr per sq ft per deg TD for each inch of thickness for batts or blankets and loose fill, respectively. For thicknesses up to 6 in., curves are given for both batts or blankets (dashed curves) and loose fill (solid curves), since both types are available and in common use. Heat-loss scales are given both in terms of watts and Btu's to suit the familiarity of the user.

These curves may also be used for masonry walls faced with studs on the inside.

Where air spaces are involved, slight discrepancies may be introduced by applying the same curves to wall, floor and ceiling constructions due to the variation in insulating effect of the air spaces with direction of heat flow. However, such discrepancies will probably have less effect on the overall result than variations introduced during construction.

FIG. 21 CEILINGS, FLOORS AND WALLS Insulation completely fills joist or stud space.

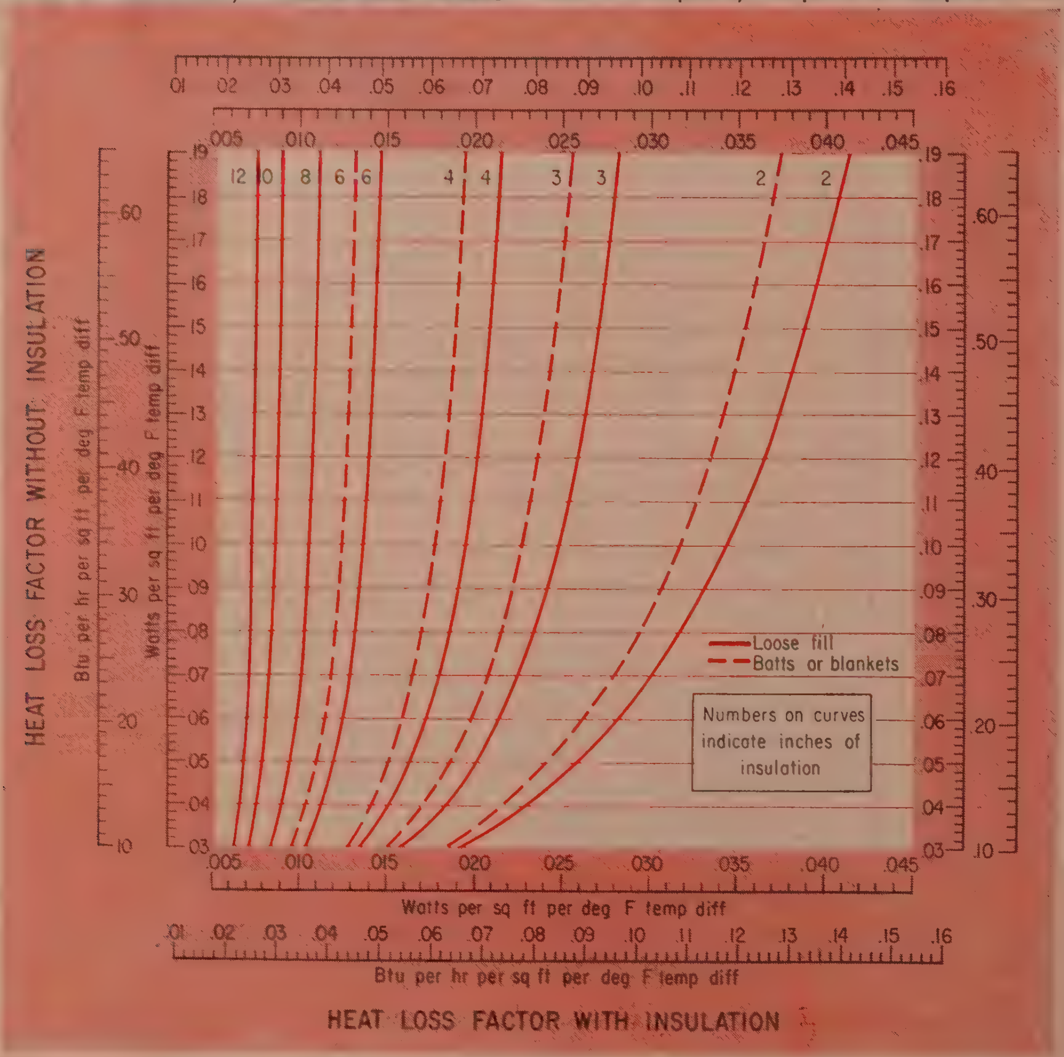
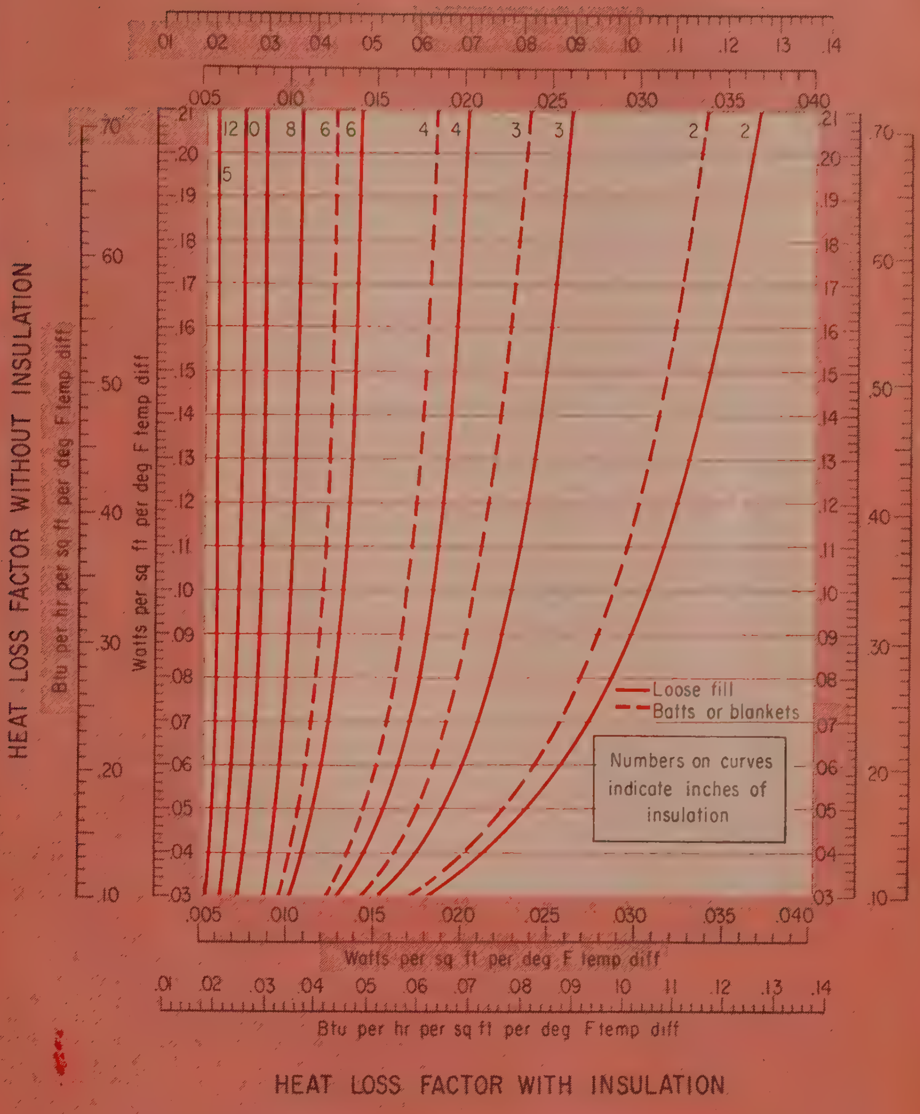


FIG. 22. CEILINGS, FLOORS AND WALLS Insulation partially fills joist or stud space.



Curves were plotted using conductance values given in Chapter 9, 1959 *Heating Ventilating Air Conditioning Guide.*

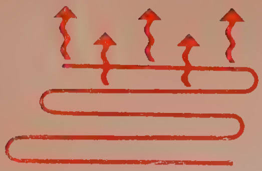
For thicknesses of insulation between those given, interpolation may be used by estimating position of intermediate curves.

A study of the curves will reveal the relative insulating value of each successive inch of insulation. Note that from 6 in. on up the curves approach a straight line, indicating the negligible effect of all common building materials on the resulting heat loss of well insulated structures.

Scales should be read as accurately as possible for use in correcting for framing; however final factors should be rounded off to two significant figures for heat-loss computations.

How to Use Curves:

1. Locate "Heat-Loss Factor Without Insulation on left-hand scales.
2. Line up ruler with same factor on right-hand scales and mark appropriate curve where it is crossed by the ruler.
3. Place ruler vertically through mark and read "Heat-Loss Factor With Insulation" on bottom (or top) scales.



CORRECTION OF HEAT-LOSS FACTORS FOR REFLECTIVE INSULATION

THESE charts, used with the factors given in Figs. 7 and 8, the first column of Fig. 6, and the first line of Fig. 3, give the heat-loss factors of walls, ceilings and floors with one or more reflective air spaces provided between framing members. The resultant factors should then be corrected for the effect of framing using Figs. 29 through 31.

The correction values given in Figs. 23 and 24 have been calculated[11] assuming the reflective surfaces positioned as shown in the accompanying sketches, with all air spaces uniform over their entire width. It is assumed that the reflective material fastened to the tops of ceiling joists is exposed to an unheated attic space; that the material on the underside of the floor joists is exposed to an unheated basement or crawl space. For other constructions, calculations should be made to fit the specific conditions as outlined in reference.[11]

The effect of floor construction on the overall heat loss factor is slight; therefore only one factor is given for each air-space combination in Fig. 23.

The curves of Fig. 25 were plotted from data given in Table 16A, Chapter 9, 1959 *Heating Ventilating Air Conditioning Guide*. They apply to frame walls or furred-out masonry walls, provided that each air space is at least ¾ in. wide.

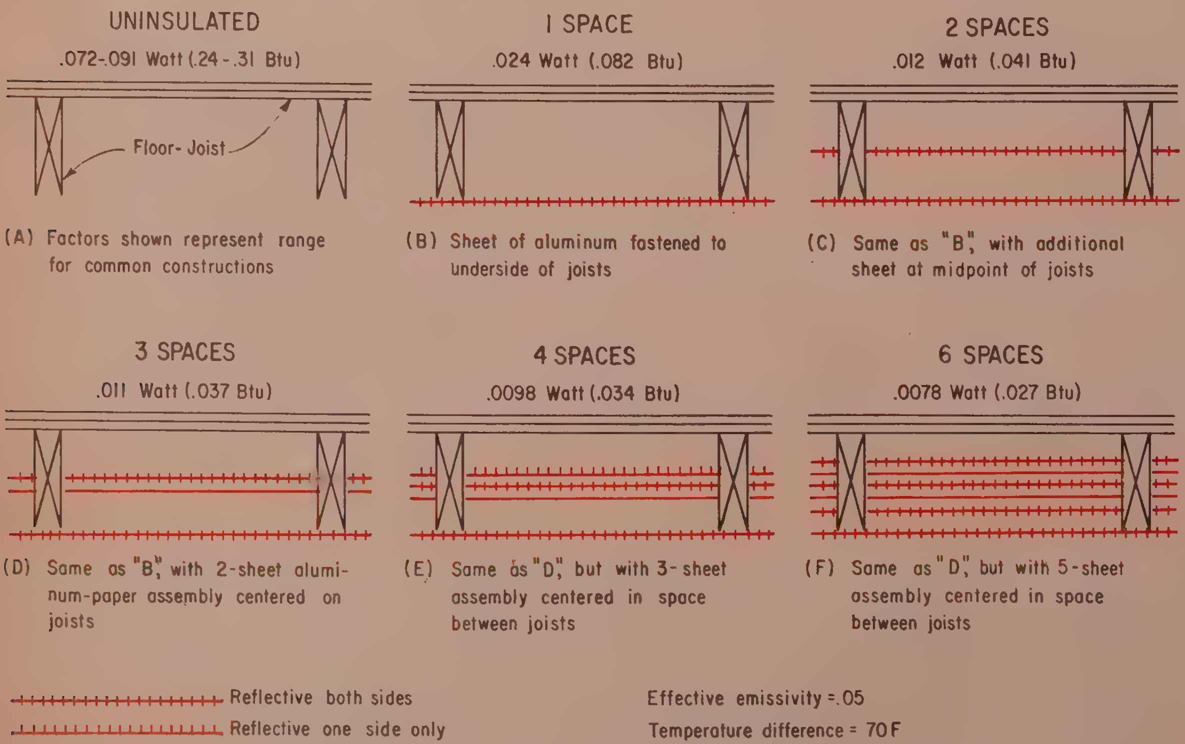
The insulating effect of reflective air spaces varies with the direction of heat flow, the thickness of the spaces, the overall temperature difference, the emissivity of the reflecting material, and the relative conductance of the building materials bounding the air spaces; therefore no single set of correction factors can hope to account for all variables. However, reasonable variations from the conditions assumed in these charts will change the results probably no more than variations introduced during construction.

Scales should be read as accurately as possible for use in correcting for framing (Figs. 29 through 31), but final factors should be rounded off to two significant figures for use in making heat-loss computations.

How to Use Curves:

1. Locate "Heat-Loss Factor Without Insulation" on left-hand scales.
2. Line up ruler with same factor on right-hand scales and mark appropriate curve where it is crossed by the ruler.
3. Place ruler vertically through mark and read "Heat-Loss Factor With Insulation" on bottom (or top) scales.

FIG. 23. FRAME FLOORS No Ceiling Below; Heat Flow Down



UNINSULATED
.072-.091 Watt (.24-.31 Btu)
(A) Factors shown represent range for common constructions

1 SPACE
.024 Watt (.082 Btu)
(B) Sheet of aluminum fastened to underside of joists

2 SPACES
.012 Watt (.041 Btu)
(C) Same as "B", with additional sheet at midpoint of joists

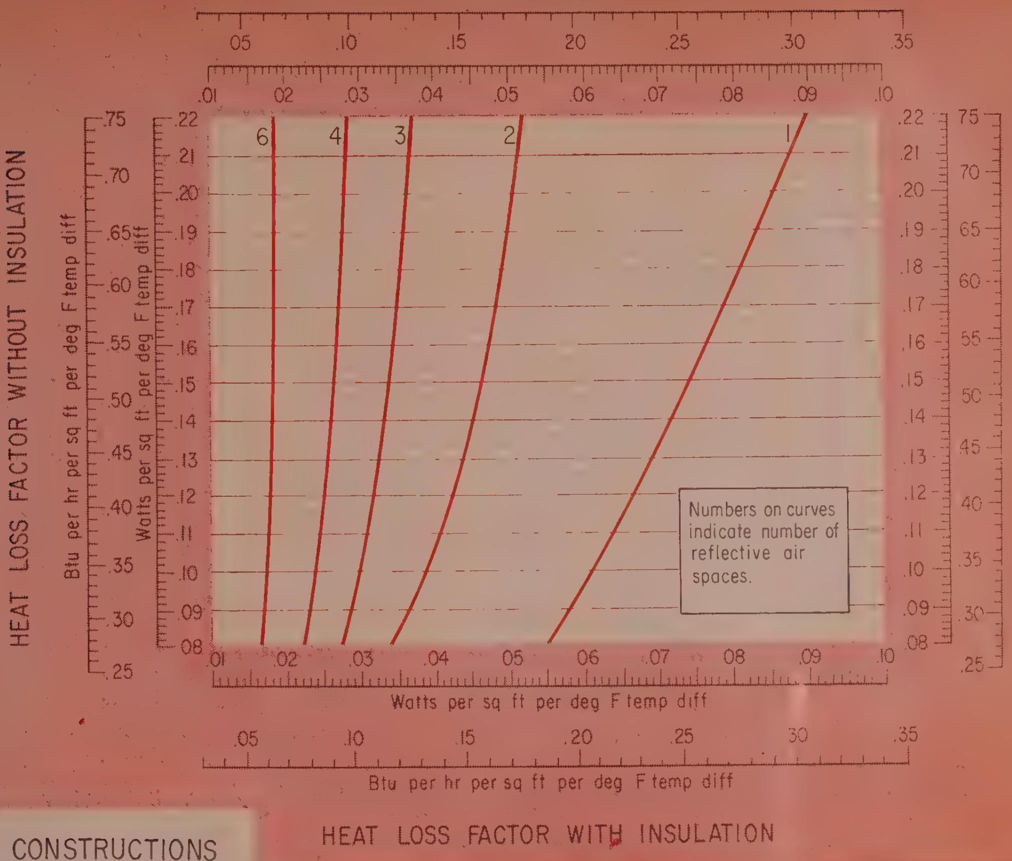
3 SPACES
.011 Watt (.037 Btu)
(D) Same as "B", with 2-sheet aluminum-paper assembly centered on joists

4 SPACES
.0098 Watt (.034 Btu)
(E) Same as "D", but with 3-sheet assembly centered in space between joists

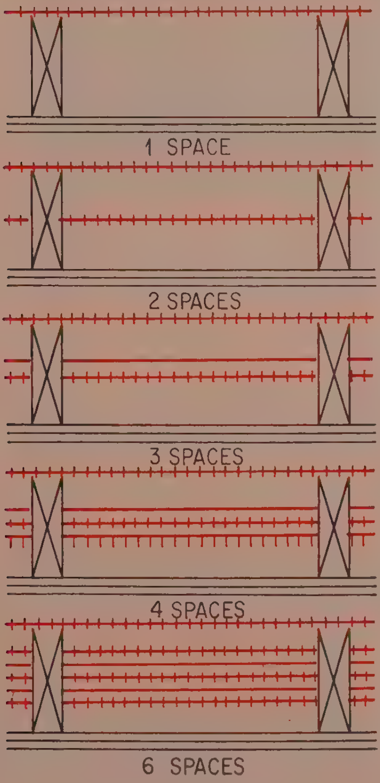
6 SPACES
.0078 Watt (.027 Btu)
(F) Same as "D", but with 5-sheet assembly centered in space between joists

Effective emissivity =.05
Temperature difference = 70F
All spaces 3/4 in. minimum

FIG. 24. FRAME CEILINGS No Floor Above; Heat Flow Up

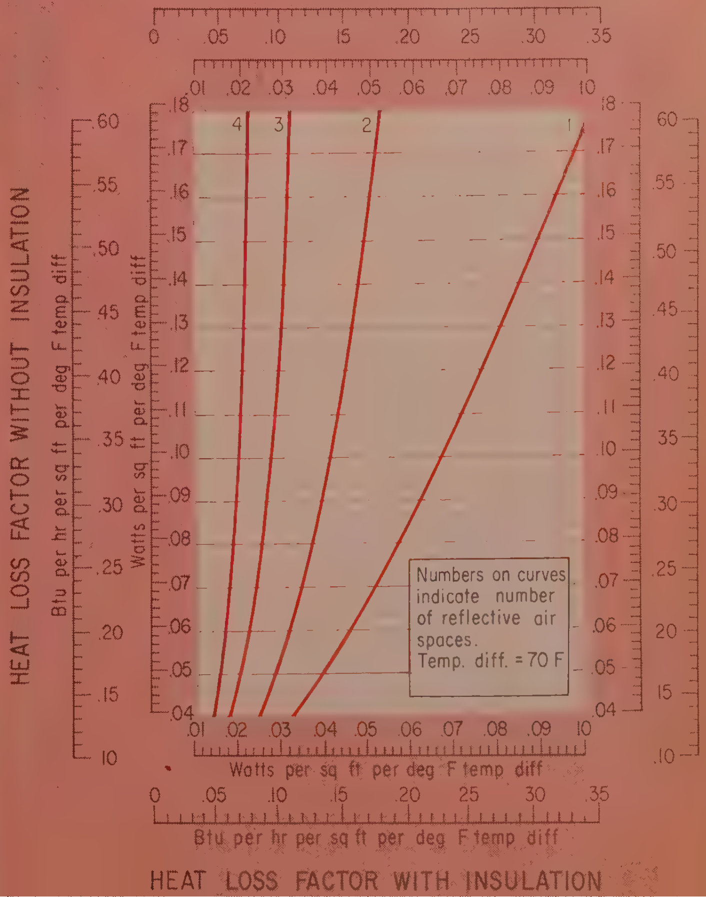


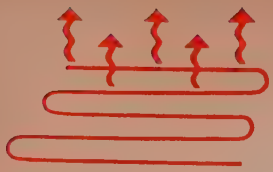
CEILING CONSTRUCTIONS
assumed in Fig. 24



Effective emissivity = .05
Temp. difference = 70 F
All spaces 3/4 in. minimum

FIG. 25. WALLS Heat Flow Horizontal





HEAT LOSS THROUGH FRAMING

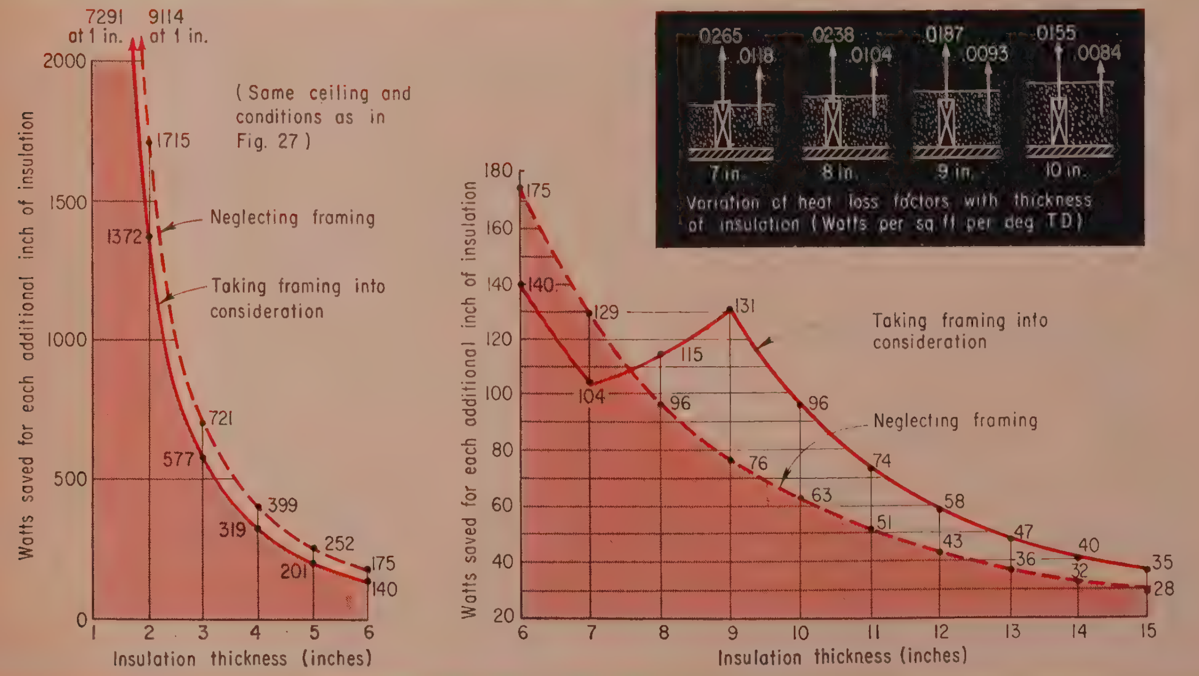
An IMPORTANT consideration too often neglected in heat-loss calculations is the effect of wood joists, studs and other framing members on the overall heat loss. In standard constructions these materials make up some 15 to 20% of the total wall, ceiling and floor areas, which is often equivalent to the area occupied by windows. Although the insulating effect of the framing is considerably greater than that of glass, the path through the framing has a significant effect on the overall heat loss in well insulated structures. The heat-loss factor through the framing should be recognized in the same manner as that of the windows.

Fig. 27 illustrates the frequently cited "law of diminishing returns," whereby each additional inch of insulation accomplishes a successively smaller reduction in overall heat loss. The two curves show (1) the usual calculated heat loss neglecting framing and (2) the true loss obtained considering the effect of framing. Note that neglecting this source of heat loss results in losses which are on the "safe" side (greater than actual) only for the first 2¾ in. in this case. For greater thicknesses, neglecting framing will give underestimated losses. The "crossover" point comes where the thermal resistance of the ceiling between the joists becomes equal to the resistance through the joists.

Disregarding the framing also results in an overestimate of the savings in heat loss accomplished by adding insulation, as shown by the left-hand portion of Fig. 26. For example, customary calculations would indicate a reduction of 9114 watts by the addition of 1 in. of insulation, whereas the actual reduction—obtained by recognizing the framing effect—is only 7291 watts.

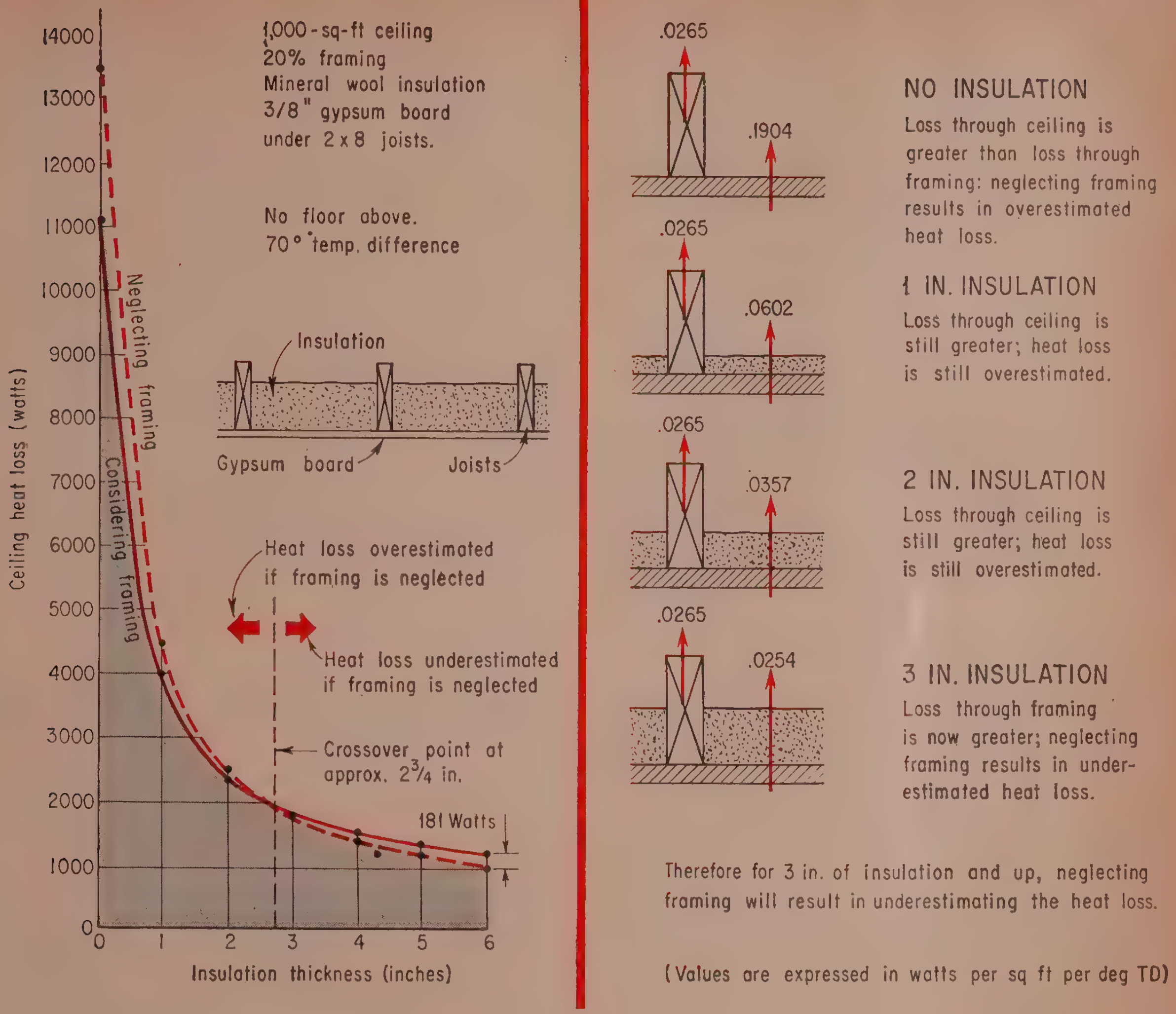
It would appear, therefore, that since the curves get closer together as the insulation thickness increases, the difference in savings would become increasingly insignificant. However, an interesting thing happens to the law of diminishing returns as the thickness is increased beyond 6 in. Since there is a justifiable, growing interest in the economic aspects of insulation exceeding 6 in., the right-hand portion of Fig. 26 is presented to show the significance of

FIG. 26. EFFECT OF INSULATION THICKNESS ON HEAT SAVED



WATTS SAVED through insulating decrease rapidly after the first inch, following law of diminishing returns. Numbers on curves for this typical ceiling show decreasing increments for each added inch of insulation up to 7 in. Note that neglecting the effects of framing exaggerates the savings. Total watts saved by adding the first 7 in. amount to 10,004; neglecting framing indicates an apparent saving of 12,505 watts—an overestimate of 25%. However, going from 7 to 10 in. would show an apparent saving of 235 watts neglecting framing, as compared with a true saving of 342 watts—an **underestimate** of 31.5%. This illustrates the departure from the law of diminishing returns as insulation covers the joists and emphasizes the value of those additional three inches. Inset shows reduction of heat loss factors through joists and between joists for these thicknesses. Note that these values approach each other as insulation increases.

FIG. 27. EFFECT OF NEGLECTING FRAMING IN HEAT-LOSS CACULATIONS



NEGLECTING JOISTS in calculating heat loss for this ceiling will result in an **overestimate** of heat loss for insulation thicknesses up to about 3 in. and an **underestimate** of losses for greater thicknesses. For the typical ceiling construction shown, the resulting error with 6 in. of insulation will be 181 watts, which is an underestimate of 16%. Inset shows how heat conductance through framing approaches and finally exceeds ceiling conductance with successive increases in insulation.

framing in such analyses. These curves are extensions of the left-hand curves beyond 6 in., at an increased scale. Note that the effect of adding the seventh inch is a continuation of the effect of adding the first 6 in. *But both the eighth and ninth inches produce a greater reduction in heat loss than the seventh inch,* and the effect of each succeeding inch is much greater than would be expected through usual calculations neglecting framing. This peculiar behavior of the curves occurs because, after the insulation reaches the top of the 7⅝-in. joists, it begins to *cover* the joists. From then on, the loss through the joists is no longer constant but begins to decrease. Adding the eighth inch adds ⅝ in. insulation over the joists; thus the heat loss reduction is greater than that afforded by the seventh inch, which was applied completely *between* the joists. Similarly, a still-greater saving is accomplished by adding the ninth inch, since it adds a full inch of insulation over the joists. From then on, each inch adds the same resistance over the joists, and the reduction in heat loss again follows the law of diminishing returns.

It is apparent that it would not make sense to add a seventh inch and then fail to at least investigate the economics of still greater insulation, since both the eighth and ninth inches effect much greater savings than does the seventh inch.

Figs. 29 through 31 provide a means for evaluating the loss through the framing. Since this loss is dependent upon the thickness of the studs or joists, the nature of the area they occupy, and the construction of the walls, ceilings, and floors, it would be impractical to provide tables of heat-loss factors taking all these variables into account. Therefore a simple formula is presented which, together with the tabular data provided, permits accurate modification of the floor, wall, and ceiling heat-loss factors to account for the effect of the framing.

FIG. 28. DESIGN HEAT LOSS: Wall Panel vs Baseboard

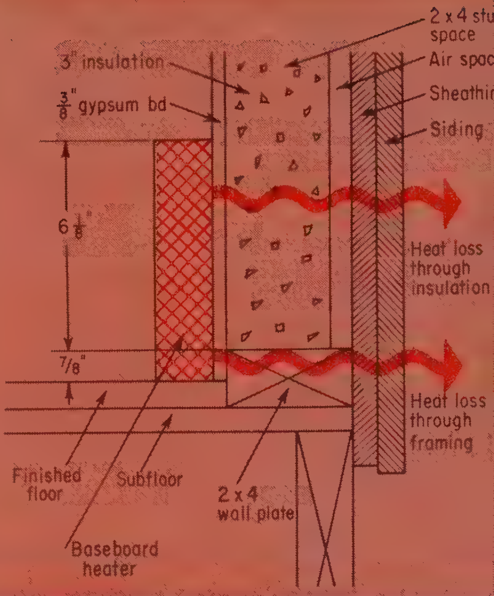
Type heater	Considering framing and heater temp.	Neglecting framing		Neglecting framing and heater temp.	
	Heat loss (watts)	Heat loss (watts)	Error	Heat loss (watts)	Error
Wall panel (surface-mounted between studs)	169.5	141.5	16.5% low	131	22.1% low
Baseboard unit (surface-mounted at floor)	174.2	141.5	18.7% low	131	24.8% low

Calculations were based on an 8x12-ft windowless wall insulated with 3-in. mineral wool batts between 2x4 studs; finished with ⅜-in. gypsum board inside, wood sheathing and siding outside.

Heater area 7 sq ft; baseboard dimensions as shown in sketch; rear surface temperature 150F.

Wood framing occupies 21% of total wall area.

Design temperatures 70F indoors, 0 deg F outdoors.



How to Correct For Framing:

A. *If insulation is between framing members only:*

(1) Find uncorrected heat loss factor of wall, floor or ceiling under consideration (without insulation) from Figs. 3, 6, 7 and 8.

(2) Locate that factor in the first column of the appropriate table on these pages.

(3) Read across to the appropriate stud or joist column and find u_f, the heat loss factor through the framing.

(4) To find the average heat-loss factor u_{av} for the entire ceiling, floor, or wall, substitute in the following formula:

$$u_{av} = ku_f + (1 - k)\,u_i$$

where

u_i = heat-loss factor between framing, corrected for insulation (from Figs. 21 through 25)

u_f = heat-loss factor through framing

k = percent framing, expressed as a decimal.

B. *If fibrous insulation fills ceiling joist space and also completely covers tops of joists:*

(1) Find u_f as above.

(2) Calculate u_{fi}, the heat-loss factor through joist plus t inches of insulation over joist, using the following formula:

$$u_{fi} = \frac{u_f}{1 + 11.4u_f t}$$

(3) Calculate u_{av} using the following formula: (Formula assumes use of loose-fill mineral wool or equivalent.)

$$u_{av} = ku_{fi} + (1 - k)\,u_i$$

Note: u_{av} is the average heat loss factor (watts/sq ft/deg TD) for the entire ceiling, floor, or wall, corrected both for the effect of framing and insulation.

CORRECTION FOR FRAMING EFFECT

FIG. 29. HEAT LOSS FACTOR u_f THROUGH WALL STUDS

Heat Loss Factor from Fig. 7 & 8 (watts/sq ft/deg TD)	U_f (watts/sq/ft/deg TD)		
	2x3 studs	2x4 studs	2x6 studs
.040	.031	.027	.022
.045	.033	.029	.023
.050	.036	.031	.025
.055	.038	.033	.026
.060	.041	.035	.027
.065	.043	.036	.028
.070	.045	.038	.029
.075	.047	.039	.029
.080	.049	.041	.030
.085	.051	.042	.031
.090	.053	.043	.031
.095	.054	.044	.032
.100	.056	.045	.033
.105	.058	.046	.033
.110	.059	.047	.034

The foregoing analysis has assumed an unheated ceiling. The effect of the framing would be more pronounced in ceiling cable installations, where the non-beneficial upward flow of heat from the cable is accentuated by the greater temperature difference between the ceiling and the unheated space above.

Cost Considerations

Observed differences in operating costs among the various types of electric heating equipment may seem odd, since 100% of the electricity is converted to heat.

However, one contributing effect is understandable if the effect of framing is again considered. A wall panel, for example, may be surface-mounted on an outside wall between two studs. It loses heat from its rear surface through the wall insulation to the outside. A baseboard unit, on the other hand, is installed at the base of the wall. Part of its wall heat loss occurs through the bottom 2 by 4 wall plate, part through the wall studs, and the remainder through the insulation. Assuming both wall and baseboard heaters to be of the same rating, area, and temperature, the baseboard heater would have the greater rate of heat loss, since the resultant conductance through framing and insulation is greater than through insulation alone.

The difference is accentuated by the fact that a greater temperature difference exists between the rear surface of the heater and outdoors than between room air and outdoors. Rear surface temperatures range between 100F and 170F, depending upon many construction variables. Therefore heat loss through portions of the wall (or ceiling) covered by heating units should be calculated on the basis of this actual heater-to-outside temperature at design condition.

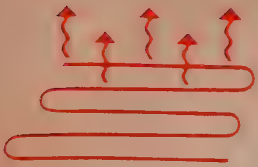
Fig. 28 shows the extent to which framing and heater temperature affect heat-loss calculations for two typical installations considering only a single 8- by 12-ft wall (windowless, for simplicity). The difference between the two, not evident if these factors are neglected, turns out to be 4.7 watts. The table also shows that failure to take these factors into account could result in underestimating required capacity by up to 24.8% for the given conditions. These figures apply only to wall losses. Similar reasoning applies to losses through floor framing, which are greater from a baseboard unit resting on the floor than from a wall-mounted panel.

FIG. 30. HEAT LOSS FACTOR u_f THROUGH FLOOR JOISTS

Heat Loss Factor from Fig. 3 (Watts/sq ft /deg TD)	u_f (watts/sq ft/deg TD) With no ceiling below joists			u_f (watts/sq ft/deg TD) With ceiling below joists		
	2x8 joists	2x10 joists	2x12 joists	2x8 joists	2x10 joists	2x12 joists
.030	.015	.013	.012	.016	.014	.013
.040	.017	.015	.013	.018	.016	.014
.050	.019	.016	.014	.020	.018	.015
.060	.020	.017	.015	.022	.019	.016
.070	.021	.018	.016	.023	.020	.017
.080	.022	.019	.016	.024	.020	.017
.090	.023	.019	.016	.025	.021	.018
.100	.024	.020	.017	.025	.021	.018
.110	.024	.020	.017	.026	.022	.018

FIG. 31. HEAT LOSS FACTOR u_f THROUGH CEILING JOISTS

Heat Loss Factor from Fig. 6 (watts/sq ft /deg TD)	u_f (watts/sq ft/deg TD) With no floor above joists			u_f (watts/sq ft/deg TD) With floor above joists		
	2x6 joists	2x8 joists	2x10 joists	2x6 joists	2x8 joists	2x10 joists
.040	.020	.017	.015	.022	.018	.016
.050	.023	.019	.016	.024	.020	.017
.060	.025	.020	.017	.026	.022	.018
.070	.026	.021	.018	.028	.023	.019
.080	.027	.022	.019	.030	.024	.020
.090	.029	.023	.019	.031	.025	.020
.100	.029	.024	.020	.032	.025	.021
.110	.030	.024	.020	.033	.026	.021
.120	.031	.024	.020	.034	.026	.022
.130	.032	.025	.021	.035	.027	.022
.140	.032	.025	.021	.035	.027	.022
.150	.033	.026	.021	.036	.028	.022
.160	.033	.026	.021	.037	.028	.023
.170	.033	.026	.021	.037	.028	.023
.180	.034	.026	.021	.037	.029	.023
.190	.034	.027	.022	.038	.029	.023
.200	.034	.027	.022	.038	.029	.023
.210	.035	.027	.022	.039	.029	.023
.220	.035	.027	.022	.039	.029	.024



HEATING COSTS

FIG. 32 DEGREE-DAY FORMULAS FOR ESTIMATING ANNUAL HEATING COST

NEMA Formula:

$$\text{Kwhr} = \frac{\text{HL} \times \text{DD} \times \text{C}}{\text{TD}}$$

FHA Formula:

$$\text{Kwhr} = \frac{\text{H} \times \text{DD}}{\text{TD} \times 185}$$

Kwhr = annual energy, kwhrs
HL = design heat loss, kw
H = design heat loss, Btu/hr
DD = degree-days
C = constant (18.5 is recommended as a conservative value)
TD = design temperature difference, deg F. (usually 70° − outside design temp., where 70° = indoor design, or control, temperature)

In each case, the resulting annual energy is multiplied by the electrical rate in cents/kwhr to obtain the annual cost. Demand charges where they exist must be added to the cost.

Both formulas give identical results if C = 18.5.

UNTIL electric heat has established widespread patterns of experience in operating costs, the designer or installer must be prepared to furnish reasonably accurate cost estimates. The best yardstick of course is a backlog of operating data on thousands of installations of all types in all parts of the country. But accurate records of electrical consumption for heating purposes require separate metering equipment and a considerable expenditure of time; hence accumulation and dissemination of such data is a slow process. To fill the gap, effort must be made to refine estimating methods to produce reliable results. For the present, high estimates will discourage use of the equipment; low estimates will cause user dissatisfaction when they are not realized.

Both the National Electrical Manufacturers Association and the Federal Housing Authority have developed general formulas for this purpose[1,2], the former in an attempt to set an industry standard and the latter for establishing a basis for loan approvals on new homes with electric heat. These formulas are presented in Fig. 32. By converting Btu/hr to kw in the FHA formula and inverting the constant to the numerator, it will be seen that both formulas are identical.

The NEMA formula is modified where found advisable by changing the constant 18.5 up or down to yield results conforming with experience. In general, different values of this constant are used in different parts of the country and for different types of heating equipment, glass areas, and orientations. Since the formula makes no direct provisions for considering existing variables which are not proportional to the degree-days (heat from lights and appliances, solar heat, body heat, slab losses, wind effect, etc.), it is unrealistic to expect a single constant in the formula to be universally applicable.

An understanding of the real meaning of degree-days, heat loss, design and average temperatures, etc., as covered in previous sections, will permit a closer investigation of energy consumption and more intelligent use of any chosen formula. It will help to examine the derivation of the degree-day formula.

It is important to bear in mind that heat loss calculations discussed previously were based on the outdoor *design* temperature—that temperature which represents the most severe conditions with which the heating system must be expected to cope (except for isolated short-time temperature dips). Estimates of annual energy usage, however, must be based on *average* temperatures, since the design temperature certainly is not expected to exist throughout the heating season. The actual seasonal heat required (annual heat loss) would thus be a certain proportion of the heat which would be needed if the design temperature *did* exist. This proportion may be given as

$$\frac{70°\text{—ave. outdoor temp.}}{\text{design temp. diff.}}.$$

The total seasonal heat loss would thus be

$$\frac{\text{heat loss}}{\text{hour}} \times 24\,\frac{\text{hours}}{\text{day}} \times \frac{\text{heating days}}{\text{year}} \times \frac{70°\text{—ave. temp.}}{\text{design temp. diff.}}$$

or

$$\text{kwhrs per year} = \frac{\text{kw} \times 24 \times \text{heating days} \times (70°\text{—}t_{av})}{\text{design TD}}.$$

It has been the practice to avoid working with the average temperature and the number of heating days by using the concept of degree-days as recorded by the U. S. Weather Bureau, where

$$\text{degree-days} = (\text{heating days}) \times (65°\text{—}t_{av}).$$

To use degree-days in our formula, we may say that

$$\text{K degree-days} = (\text{heating days}) \times (70°\text{—}t_{av}),$$

and the formula becomes

$$\text{kwhrs per year} \times \frac{\text{kw} \times 24\text{K} \times \text{degree-days}}{\text{design TD}},$$

where

$$\text{K} = \frac{70°\text{—}t_{av}}{65°\text{—}t_{av}}.$$

Except for a few cities in the deep South, K will vary between 1.14 and 1.67, indicating that the constant designated as 18.5 in the NEMA formula would

FIG. 33. THE DEGREE-DAY

For the past 45 years the degree-day has been a useful tool in estimating fuel requirements for heating systems. Through original observations of gas-heated structures, it was found that, for maintained indoor temperatures of 68 to 72F, heating plant operation didn't commence until the outdoor temperature dropped below 65F. Thus the heating season is said to begin in any given area when the outdoor mean temperature drops below 65F in the fall and ends when the mean temperature again rises above 65F in the spring, based on recorded observations over many years.

The outdoor mean temperature was related to the heating season through degree-days, the number of degree-days recorded for any one day being the difference between 65F and the mean temperature for that day when the latter is less than 65F. Thus if the mean temperature for a specific day is 55F, 10 degree-days are recorded for that day. Since 65F is used as the reference point, such degree-days are said to be calculated on a 65F base. (For indoor temperatures other than approx. 70F, a different base must be used.)

The total degree-days for a heating season are obtained by summing up the individual daily degree-days. It may be shown that **degree-days = heating days × (65F − mean temp),** from which may be developed the relationship

$$\textbf{seasonal mean temp.} = 65^\circ - \frac{\textbf{degree-days}}{\textbf{heating days}}.$$

The daily mean temperature is the temperature midway between the highest and lowest hourly temperature recorded during the day. Thus if the day's temperature varies between 68F and 56F, the mean temperature for the day is 62F. Such a mean temperature is not a true average temperature, but except for a few cities on the West Coast, the two are close enough so that the mean temperature may be taken as the average temperature. Where this assumption is not warranted, the degree-day process may be applied on an hourly basis, thus obtaining *degree-hours.* Representing an hourly record of the deviations from 65F, degree-hours provide a more accurate picture of average temperature.

While it may be assumed that increased use of electricity in the all-electric home as compared with average usage 45 years ago has affected the 65F base premise to a certain extent, the fact that accumulated weather data is recorded using this base makes it expedient to use the data for electric heat, making such adjustments as appear to be valid as dictated by experience. The difference between degee-days to a 65F base and 70F base is often used to give an approximation of heat gains from sources other than the heating system.

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theoretically vary approximately between 27 and 40.

Experience has shown that this is not so. Actual operation of electric heating systems indicates a range of from 11 to 24, varying with the type of construction, glass area, orientation, geographical location, etc. The value of 18.5 chosen by NEMA indicates a value of 0.77 for K, which would seem to mean an efficiency in excess of 100%.

Actually, the discrepancy exists in the fact that the above formula was developed as *annual heat loss.* The actual *annual heat requirement* must be less due to the many sources of heat which contribute to the structure other than the heating plant, such as heat from lighting and appliances, solar heat, body heat, etc. Herein lies one of the main disadvantages of any degree-day formula, no matter what constant is chosen: it assumes that these heat gains are proportional to the design heat loss and the degree-days and inversely proportional to the design temperature difference. But solar heat varies greatly with geographical location, and heat from lighting and appliances is independent of all these factors; therefore a single constant cannot accurately correct the formula for these heat gains.

Ideally, the theoretical formula should be used to find the annual heat loss, with expected heat gains then subtracted to give the net heating requirement. Admittedly, these heat gains are not easy to anticipate accurately[3]. A reasonable contribution from lighting and appliances over a 9-month heating season in an all-electric home is 5,000 kwhr. Similar estimates can be made for specific commercial, industrial, or institutional structures considering heat from lighting, motors, business machines, body heat, etc. Recorded solar heat data for specific areas may also be applied, although the construction, orientation, glass area, and landscaping of each specific case will vary this value greatly. More research and assimilated data on solar heat is needed before general practical evaluations can be made.

Similarly, additional heat losses such as mechanical ventilation must be subtracted from the annual heat loss as calculated by the degree-day formula. Since the formula as derived above assumed a 70F indoor control temperature, any application requiring a lower or higher control point necessitates use of degree-days to a base other than 65F. Degree-days to the bases of 45F and 55F have been compiled for applications requiring a control point of 50F and 60F respectively. For other control points, degree-days must be calculated to the appropriate base (usually taken as 5 degrees below the control point) by the user. Fig. 34 shows how these considerations were handled in the design of a school's electric heating system[4].

A relatively simple method has been proposed[5] to provide heat requirement data for electrically heated homes from utility meter readings without the necessity of evaluating extra heat gains as such (see Fig. 35). Tabulated data of this type from all utility areas with supporting information on type of system, orientation, etc., would be extremely beneficial in testing the validity of any estimating formula.

The degree-day formula is also invalid with respect to heat loss from slab floors, floors over basements or unventilated crawl spaces, and heated ceilings, none of which are proportional to the degree-days. The earth temperature has a greater effect than the average outdoor temperature on crawl space and unheated basement temperatures and upon heat loss from heated or unheated slabs. Similarly, cable-heated ceilings change the definition of "average tempera-

FIG. 34. HEATING COST CALCULATIONS

Heat Loss:

Structure only (excluding infiltration and ventilation): 116 kw
(or 34.8 kwhr per degree-day)*
Infiltration plus ventilation: 85 kw
(or 25.5 kwhr per degree-day)*
Infiltration alone: 68 kw
(or 20.4 kwhr per degree-day)*

$$* \text{ kwhr per degree-day} = \frac{\text{kw heat loss} \times 24 \text{ hrs/day}}{80 \text{ deg temp diff}}$$

Rate of Loss:

Structure only:
70F to be maintained 9½ hrs/day × 5 days/wk or 47½ hrs/wk
(or 28.3% of the time)
50F to be maintained at all other times
(or 71.7% of the time)
Infiltration plus ventilation:
This condition occurs 6½ hrs/day × 5 days/wk or 32½ hrs/wk
(or 19.3% of the time)
Infiltration only:
This condition occurs at all other times
(or 80.7% of the time)

Degree-Days:

To the base 65F: 5600 To the base 45F: 1760

(Degree-days are used to the normal 65F base when temperatures are to be kept at a normal 70F. However, maintaining the temperature 20 degrees lower, at 50F, necessitates use of a 20-degree lower base.)

Annual Energy Consumption:

Structure:
Day: 34.8 kw × 5600 D.D. × 28.3% = 55,151 kwhr/yr
Night: 34.8 kw × 1760 D.D. × 71.7% = 43,915 kwhr/yr
Ventilation plus infiltration:
25.5 kw × 5600 D.D. × 19.3% = 27,560 kwhr/yr
Infiltration only:
20.4 kw × 1760 D.D. × 80.7% = 28,975 kwhr/yr
Total (for dark, empty building): 155,601 kwhr/yr

Heat Credits:

Sensible heat emission:
180 children × 150 Btu/hr/child: 7.9 kw
Lighting fixtures: 16.0 kw
Total: 23.9 kw

This credit, however, applies only during the 21.5 weeks of the year that heating is normally required:
23.9 kw×6½ hrs/day×5 days/wk×21.5 wks/yr=16,700 kw/yr credit.
The difference between keeping the rooms at 70F and 50F during the 2-week Christmas vacation is 804 kwhr:
16,700 kwhr + 804 kwhr = 17,504 kwhr total credit.

Cost:

Net energy requirements for year = 155,601 kwhr — 17,504 kwhr
= 138,097 kwhr
At 2¢/kwhr, estimated annual cost = $2761.94
Actual metered cost for first year, Oct. through May: $2669.60

ANNUAL ENERGY COSTS involved in heating an all-electric school were calculated as above[4], taking into consideration heat gains form other sources and losses attributed to ventilation, plus an evaluation of losses for part-time use of a control point other than 70F. No credit was taken for solar heat, which remains a plus value on the safe side.

ture difference" in the derivation of the degree-day formula. Where any of these conditions exist, the floor or ceiling losses should be calculated separately and then added to the results of the formula[c].

Armed with a formula or estimating method, the contractor, architect, or engineer is in a position to provide the prospective customer or client with an annual operating figure. Usually, a cost estimate is based on average degree-days for the area (see Fig. 38). But if the first winter is an unusually cold one, it may be difficult to explain the unexpected cost. An intelligent way to handle this problem is to give estimates of what the proposed system *would have cost* in each of the past five years, using actual recorded degree-days in the calculations. This gives the customer or client an idea of how the costs vary with the severity of the heating season, and he is better prepared to understand deviations from the estimates.

It should also be explained that heating costs for the first year of operation of a heating system should be expected to be higher than in subsequent years with the same degree-days, since considerable

FIG. 35. ANNUAL HEATING REQUIREMENTS FROM METER READINGS

A simple method for measuring annual kwhrs used for heating without resorting to separate metering may be obtained by a curve such as is shown here, proposed as a method for determining heat losses in electrically heated structures[5]. By plotting the monthly electric bills (taken from utility meter route books) vs recorded degree-days for the periods covered by the bills and drawing a straight line through the plotted points, it will be seen that the point of intersection of the line with the vertical zero axis represents the average energy used per month for purposes other than heating in the home. Subtracting this from the total energy used gives the amount used for heating. The same process may be used for bi-monthly billing, of course. (Plotting the kwhrs vs degree-hours instead of degree-days provides additional data for checking design heat requirements.)

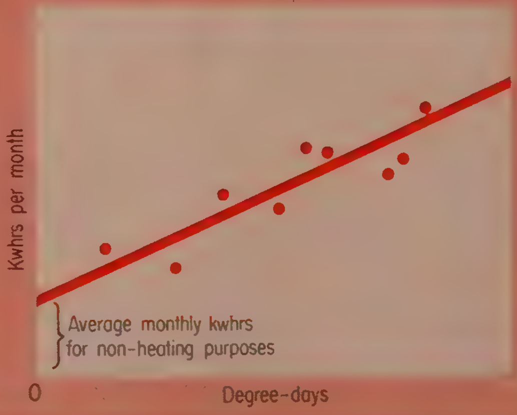


FIG. 36. TYPICAL UTILITY RATES

Following are examples of rates currently being used by electrical utilities serving customers with electric space heating loads.

Connecticut Light & Power Co.
Berlin, Conn.

The same rate structure applies to heating and non-heating loads: 1.9¢/kwhr in excess of 1000 per month.

Kansas City Power & Light Co.
Kansas City, Mo.

For the all-electric home during heating months only, 1.3¢/kwhr in excess of 1000 per month.

Kansas Power and Light Co.
Topeka, Kans.

For residential space-heating of 2 kw or more during 7-month heating period: 1.25¢/kwhr in excess of 1000.

For commercial space-heating during 7-month heating period: 1.25¢/kwhr, in the form of a demand concession.

For electrically heated schools during 7-month heating period: 1.25¢/kwhr, based on blocks of kwhrs per connected kw.

Union Electric Co.
St. Louis, Mo.

For all residential uses over 8-month heating period, 1.35¢/kwhr in excess of 1000 per month.

Special industrial and commercial net rate for heating: 1.5¢/kwhr over 8-month period.

Mississippi Power & Light Co.
Jackson, Miss.

The same rate structure applies to heating and non-heating loads: from 161 through 1700 kwhrs, 1.2¢/kwhr; additional kwhrs, 1.0¢/kwhr.

Texas Power & Light Co.
Dallas, Tex.

For permanently installed heating equipment of 2 kw or more during 6-month heating season, 1.25¢/kwhr.

Heating energy defined as number of kwhr in final block of residential service rate in excess of 450 during heating season.

Louisiana Power & Light Co.
New Orleans, La.

Same rate structure applies to heating and non-heating loads: 1.5¢/kwhr in excess of 500 per month.

Indianapolis Power & Light Co.
Indianapolis, Ind.

For complete electric heating over 8-month heating period, 1.5¢/kwhr in excess of 300 kwhr/month.

Central Illinois Public Service Co.
Springfield, Ill.

For homes with electricity as primary source of heating: 1.85¢/kwhr in excess of 1000 over 8-month heating period.

Atlantic City Electric Co.
Atlantic City, N. J.

Same rate structure for heating and non-heating loads: 1.75¢/kwhr in excess of 300.

Duquesne Light Co.
Pittsburgh, Pa.

Where electricity is the primary source of heat: First 6000 kw $144 per year; excess at 1.5¢/kwhr.

Demand charge imposed for demand in excess of 25 kw.

heat is required to remove the initial moisture inherent in new building materials. This is equivalent to saying that heat-loss factors of the walls, floors and ceilings are higher during the first year than in subsequent years. This condition will be aggravated if fibrous insulation delivered to the jobsite is allowed to absorb moisture.

Being subsequently installed between framing and protected by a vapor barrier, it may require considerable time to dry out.

Other Costs

Admittedly, electrical energy for heating costs more today than combustible fuels in many areas, although it is entirely competitive with fuels in some areas and less expensive in others, and the differential is constantly decreasing. Fig. 36 gives a summary of representative utility rates which have been devised especially for electric heating customers.

However, electric heating can best be sold by virtue of the many advantages which justify its premium cost, and by evaluating all other expenses involved which ultimately determine the true cost of the system. An item-by-item comparison will very often show electric heating to be the most economical.

Fig. 37 shows a typical comparison of such costs considerations, with check-marks indicating the system for which each factor is likely to result in the higher cost. All of these factors may not apply to a given installation, and others may be found to exist which are not listed. Where possible, a detailed analysis of this type should be made comparing the alternative heating systems for presentation to the customer, using computed dollar values based on existing conditions.

FIG. 37. COMPARISON OF OVERALL HEATING COSTS

Cost Factor	Electric	Fuel-Fired
Annual heating energy or fuel consumption	X	X
Initial heating equipment investment		X
Distribution ducts and supporting hardware		X
Chimneys and flues		X
Control and regulating devices		X
Space occupied by equipment		X
Fuel storage		X
Access roads for fuel delivery		
Electrical wiring and associated equipment	X X	
Insulation		X
Smoke-control measures		X
Salaries of attendants		
Contingencies due to additional subcontracts		X X
Radiator enclosures		
Electricity for auxiliary pumps, fans, etc.		X X
Maintenance		X
Redecorating		X
Interest on original investment		X
Taxes		X
Insurance		

ENERGY COSTS are only one factor in evaluating the overall cost of an electric heating system. An item-by-item summary of all factors using prevailing dollar values will frequently show the electric system to be more economical. In the above table, an "X" is placed opposite each factor under the system which is likely to show the greater cost in most installations.

FIG. 38. CLIMATIC DATA—U.S. CITIES

Location	Heating Season	Heating Days	Ave. Mean Temp, F	Degree-Days	Outside Design Temp, F
ALABAMA					
Anniston*	Oct 15–Apr 24	192	50.3	2820	12
Birmingham*	Oct 15–Apr 25	193	50.6	2780	12
Mobile	Nov 2–Apr 1	151	54.9	1529	22
Montgomery	Oct 25–Apr 10	168	53.4	1954	18
ARIZONA					
Flagstaff*	Aug 12–Jul 5	328	42.1	7525	−4
Phoenix	Nov 5—Apr 2	149	55.0	1492	36
Yuma	Nov 15–Mar 7	113	56.6	951	38
ARKANSAS					
Fort Smith*	Oct 16–Apr 20	187	48.0	3188	6
Little Rock*	Oct 17–Apr 21	187	49.1	2982	8
CALIFORNIA					
Eureka	....	365	52.3	4632	32
Fresno*	Oct 16–Apr 25	192	51.8	2532	32
Independence	Sept 25–May 23	241	49.1	3832	12
Los Angeles	Nov 2–May 10	190	57.4	1451	41
Sacramento	Oct 16–May 14	211	52.7	2600	30
San Diego*	Oct 22–Jun 2	224	58.0	1574	43
San Francisco	....	365	56.6	3069	37
San Jose	Oct 7–Jun 7	244	55.1	2410	38
COLORADO					
Denver	Sept 15–Jun 7	266	43.7	5673	−12
Grand Junction*	Sept 25–May 23	241	41.0	5796	−3
Pueblo*	Sept 17–May 31	257	42.8	5709	−14
CONNECTICUT					
Bridgeport*	Sept 19–Jun 5	260	42.3	5896	−1
Hartford*	Sept 12–Jun 2	264	41.7	6139	−2
New Haven*	Sept 14–Jun 8	268	42.5	6026	0
DELAWARE					
Wilmington*	Sept 27–May 19	235	44.1	4910	0
DISTRICT OF COLUMBIA					
Washington	Oct 2–May 12	223	45.9	4258	10
FLORIDA					
Jacksonville	Nov 10–Mar 21	132	56.6	1113	28
Miami	Dec 4–Mar 13	100	63.3	173	35
Pensacola	Nov 3–Apr 2	151	55.5	1435	24
Tampa*	Dec 1–Mar 3	93	57.8	674	36
GEORGIA					
Atlanta	Oct 14–Apr 25	194	50.5	2811	11
Augusta*	Oct 23–Apr 12	172	52.6	2138	20
Macon*	Oct 23–Apr 9	169	52.9	2049	20
Savannah*	Oct 28–Apr 9	164	54.6	1710	24
IDAHO					
Boise*	Sept 9–Jun 12	277	43.7	5890	−10
Lewiston*	Sept 13–Jun 8	269	44.6	5483	−12
Pocatello*	Sept 4–Jun 20	290	40.9	6976	−17
ILLINOIS					
Cairo	Oct 11–Apr 29	201	46.3	3756	0
Chicago*	Sept 21–May 29	251	39.9	6310	−11
Peoria*	Sept 22–May 27	248	40.5	6087	−13

Location	Heating Season	Heating Days	Ave. Mean Temp, F	Degree-Days	Outside Design Temp, F
INDIANA					
Evansville*	Oct 4–Jun 15	255	47.9	4360	−4
Fort Wayne*	Sept 18–May 30	255	40.3	6287	−7
Indianapolis	Oct 2–May 18	229	42.6	5134	−8
Terre Haute*	Sept 28–May 20	235	42.2	5366	−6
IOWA					
Charles City	Sept 10–May 31	264	36.6	7504	−21
Davenport	Sept 24–May 21	240	39.6	6091	−12
Des Moines	Sept 23–May 23	243	39.2	6274	−13
Sioux City*	Sept 16–May 26	253	37.3	7012	−16
KANSAS					
Concordia	Oct 2–May 19	230	41.9	5323	−11
Dodge City	Oct 2–May 20	231	43.1	5058	−9
Topeka	Oct 4–May 13	222	42.8	4919	−8
Wichita*	Oct 7–May 14	220	44.2	4571	−6
KENTUCKY					
Bowling Green*	Oct 4–May 16	225	46.0	4279	2
Lexington*	Oct 1–May 21	233	43.6	4979	−2
Louisville	Oct 6–May 10	217	45.3	4279	−2
LOUISIANA					
New Orleans	Nov 10–Mar 24	135	56.3	1175	26
Shreveport*	Oct 26–Apr 6	163	52.0	2117	14
MAINE					
Eastport	....	365	42.4	8246	−9
Portland*	Aug 27–Jun 25	303	39.7	7681	−9
MARYLAND					
Baltimore	Sept 8–May 13	248	48.1	4203	8
MASSACHUSETTS					
Boston*	Sept 17–Jun 5	262	42.9	5791	0
MICHIGAN					
Alpena	Aug 25–Jun 25	305	38.5	8073	−10
Detroit*	Sept 17–Jun 2	259	40.3	6404	−4
Escanaba	Aug 22–Jun 27	310	37.1	8657	−18
Grand Haven	Aug 31–Jun 19	293	41.4	6915	−3
Grand Rapids	Sept 16–Jun 2	260	40.1	6474	−4
Houghton	Aug 9–Jul 6	332	38.0	8964	−18
Lansing*	Sept 9–Jun 3	268	38.9	6982	−8
Marquette	Aug 24–Jul 1	312	37.7	8529	−16
Sault Ste. Marie*	Aug 8–Jul 15	342	37.3	9475	−19
MINNESOTA					
Duluth	Aug 21–Jul 5	319	35.3	9474	−27
Minneapolis*	Sept 11–May 31	263	35.1	7853	−23
Moorhead	Aug 23–Jun 16	298	34.0	9315	−29
St. Paul*	Sept 11–Jun 1	264	35.4	7804	−23
MISSISSIPPI					
Meridian*	Oct 17–Apr14	180	52.0	2333	14
Vicksburg	Oct 26–Apr 8	165	52.9	2000	15
MISSOURI					
Columbia*	Sept 29–May 17	231	42.9	5113	−9
Hannibal	Sept 24–May 29	239	43.1	5248	−12
Kansas City*	Oct 5–May 12	220	42.8	4888	−8
St. Louis	Oct 8–May 10	215	44.2	4469	−5
Springfield*	Oct 1–May 19	231	44.7	4693	−5

Asterisks indicate airport stations; others are city office stations.
Average temperature = 65—(degree-days/heating days).
Outside design temperature given is that which is likely to recur once every 13 years as the minimum daily mean temperature.

Location	Heating Season	Heating Days	Ave. Mean Temp, F	Degree-Days	Outside Design Temp, F
MONTANA					
Billings*	Sept 4–Jun 16	286	40.2	7106	−31
Havre	Aug 29–Jun 22	298	37.4	8213	−39
Helena	Aug 20–Jul 3	318	39.4	8126	−39
Kalispell*	Aug 17–Jul 5	323	40.1	8055	−31
Miles City*	Sept 7–Jun 13	280	37.1	7822	−35
NEBRASKA					
Lincoln	Sept 27–May 21	237	40.3	5865	−15
North Platte*	Sept 15–Jun 1	260	39.8	6546	−15
Omaha*	Sept 24–May 20	239	39.2	6160	−17
Valentine	Sept 12–Jun 5	267	38.5	7075	−21
NEVADA					
Reno*	Sept 4–Jun 26	296	44.6	6036	3
Winnemucca*	Sept 4–Jun 17	287	42.8	6369	− 9
NEW HAMPSHIRE					
Concord*	Aug 29–Jun 15	291	38.8	7612	−11
NEW JERSEY					
Atlantic City	Sept 29–May 30	244	45.6	4741	− 8
Elizabeth	Sept 20–May 24	247	43.5	5302	2
New Brunswick	Sept 17–May 30	256	43.9	5404	4
Plainfield	Sept 16–Jun 1	259	43.6	5535	4
Somerville	Sept 18–May 29	254	43.1	5586	2
Trenton	Sept 25–May 21	239	43.8	5068	2
NEW MEXICO					
Albuquerque*	Oct 3–May 12	222	45.2	4389	8
Roswell*	Oct 8–May 3	208	48.5	3424	4
Santa Fe	Sept 1–Jun 15	287	43.9	6063	3
NEW YORK					
Albany	Sept 15–May 28	256	40.3	6319	− 9
Binghamton*	Aug 30–Jun 16	291	39.1	7537	− 7
Buffalo*	Sept 10–Jun 9	273	40.0	6838	− 5
Ithaca	Sept 4–Jun 9	279	40.9	6719	− 4
New York	Sept 28–May 26	241	44.0	5050	5
Oswego	Sept 9–Jun 15	280	40.1	6975	− 7
Rochester*	Sept 9–Jun 6	271	39.7	6863	− 4
Syracuse*	Sept 13–Jun 2	263	40.2	6520	−10
NORTH CAROLINA					
Asheville	Sept 29–May 19	233	47.5	4072	5
Charlotte*	Oct 9–Apr 30	204	49.3	3205	14
Hatteras	Oct 23–May 3	193	52.6	2392	21
Raleigh	Oct 12–May 1	202	49.8	3075	14
Wilmington*	Oct 19–Apr 24	188	52.6	2323	20
NORTH DAKOTA					
Bismarck*	Aug 31–Jun 16	290	33.9	9033	−31
Devils Lake	Aug 27–Jun 22	300	31.9	9940	−32
Grand Forks	Aug 15–Jun 23	313	33.8	9764	−31
Williston	Sept 1–Jun 19	292	33.9	9068	−35
OHIO					
Cincinnati	Oct 4–May 14	223	44.7	4532	− 3
Cleveland	Sept 23–May 29	249	42.0	5717	− 5
Columbus	Sept 27–May 22	238	42.8	5277	− 3
Dayton*	Sept 25–May 25	243	42.0	5597	− 4
Sandusky	Sept 23–May 29	249	41.5	5859	− 4
Toledo*	Sept 16–May 31	258	40.2	6394	− 5
OKLAHOMA					
Oklahoma City	Oct 16–Apr 27	194	46.9	3519	− 1
OREGON					
Baker	Aug 25–Jul 4	314	42.4	7087	−14
Portland	Sept 16–Jun 18	276	50.0	4143	10
Roseburg	Sept 13–Jun 19	280	50.3	4122	19

Location	Heating Season	Heating Days	Ave. Mean Temp, F	Degree-Days	Outside Design Temp, F
PENNSYLVANIA					
Erie	Sept 20–Jun 4	258	41.3	6116	− 3
Harrisburg*	Sept 22–May 20	241	43.2	5258	4
Philadelphia	Oct 2–May 17	228	45.2	4523	6
Pittsburgh	Sept 28–May 19	234	43.4	5048	− 3
Reading	Sept 26–May 21	238	43.7	5060	3
Scranton	Sept 15–May 30	258	41.6	6047	− 2
RHODE ISLAND					
Block Island*	Sept 13–Jun 19	280	44.1	5843	7
Providence	Sept 18–Jun 1	257	43.2	5607	1
SOUTH CAROLINA					
Charleston	Oct 28–Apr 10	165	54.3	1769	22
Columbia	Oct 19–Apr 17	181	52.4	2284	19
SOUTH DAKOTA					
Huron*	Sept 12–Jun 3	265	29.8	7902	−21
Pierre	Sept 4–Jun 17	287	39.2	7420	−22
Rapid City*	Sept 5–Jun 17	286	26.3	7535	−22
TENNESSEE					
Chattanooga*	Oct 8–May 4	209	48.8	3384	8
Knoxville*	Oct 8–May 4	209	47.8	3590	5
Memphis	Oct 19–Apr 22	186	48.8	3006	6
Nashville*	Oct 11–May 2	204	47.8	3513	3
TEXAS					
Abilene*	Oct 22–Apr 14	175	49.8	2657	7
Amarillo*	Oct 2–May 17	228	45.9	4345	− 2
Corpus Christi*	Nov 15–Mar 15	121	56.6	1011	23
Dallas*	Oct 27–Apr 6	162	51.0	2272	8
El Paso*	Oct 19–Apr 19	183	50.6	2641	20
Fort Worth*	Oct 27–Apr 10	166	50.8	2361	8
Galveston	Nov 13–Mar 29	137	56.2	1211	23
Houston	Nov 8–Mar 25	138	55.8	1276	19
Palestine	Oct 30–Apr 7	160	52.6	1980	11
San Antonio*	Nov 5–Mar 29	145	54.1	1579	19
UTAH					
Salt Lake City	Sept 20–May 29	252	43.3	5463	− 1
VERMONT					
Burlington*	Sept 3–Jun 10	281	37.0	7865	−17
Northfield	Aug 8–Jul 1	328	38.6	8719	−19
VIRGINIA					
Cape Henry	Oct 12–May 12	213	49.5	3307	17
Lynchburg*	Sept 29–May 12	226	46.6	4153	11
Norfolk	Oct 13–May 7	207	49.9	3119	15
Richmond	Oct 6–May 9	216	47.8	3720	11
Wytheville	Sept 13–Jun 2	263	45.9	5022	3
WASHINGTON					
Seattle	Aug 28–Jul 2	309	50.6	4438	15
Spokane*	Aug 31–Jun 27	301	42.2	6852	−16
Tacoma	Aug 13–Jul 9	331	50.3	4866	15
Tatoosh Island	....	365	49.3	5724	18
Walla Walla	Sept 20–May 27	250	45.6	4848	−12
WEST VIRGINIA					
Elkins*	Sept 12–Jun 6	268	43.5	5773	− 4
Parkersburg	Sept 30–May 18	231	44.4	4750	− 1
WISCONSIN					
Green Bay*	Sept 2–Jun 12	284	35.9	8259	−20
La Crosse*	Sept 10–May 31	264	36.0	7650	−20
Madison	Sept 13–Jun 3	264	37.3	7300	−19
Milwaukee	Sept 15–Jun 12	271	39.4	6944	−17
WYOMING					
Cheyenne*	Aug 26–Jun 28	307	40.4	7562	−19
Lander*	Aug 29–Jun 22	298	37.1	8303	−30
Yellowstone Park	....	365	38.8	9554	−34

FIG. 39. EFFECT OF VOLTAGE ON HEATER PERFORMANCE

CONDUCTOR CHARACTERISTICS

Wire size AWG	DC Resistance (ohms per ft at 77F)		
	Copper		Aluminum
	Tinned	Not tinned	
14	.002680	.002575	....
12	.001690	.001619	.002710
10	.001060	.001018	.001700
8	.000660	.000641	.001070
6	.000426	.000410	.000674

VOLTAGE DROP FORMULAS

(Reactance negligible)

Single-phase, 2-wire circuits:

$$V = 2LRI$$

Single-phase, balanced 3-wire circuit; or 3-phase, 4-wire, balanced circuit:

$$V = LRI$$

3-phase, 3-wire balanced circuit:

$$V = 1.732LRI$$

V = voltage drop (volts)
R = conductor resistance (ohms/ft)
L = one-way circuit length (ft)
I = current (amps)

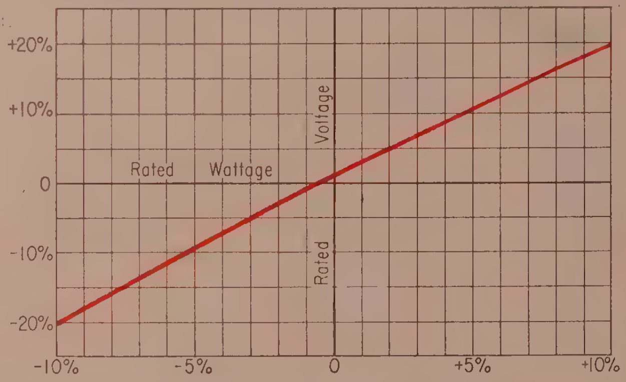
As shown by curve, heater output drops rapidly as terminal voltage is reduced; thus length of circuits should be kept to a minimum to reduce line voltage drop. Actual output of selected heaters, as affected by any voltage variations, should be calculated using formula given here and compared with room heat loss. If a wide difference exists, install heaters with a higher rating. If voltage drop is excessive, use larger circuit conductors.

Voltage available on premises must be known before obtaining heaters. A 230-volt, 1000-watt heater used on a 208-volt circuit would be operating 4.3% below rated voltage; from the curve, the output would be about 9% below rated, or 900 watts. Conversely, a 208-volt, 1000-watt heater used on a 230-volt line would be operating 10.6% above rated voltage, with an actual output 22.3% above rated, or about 1220 watts. Such operation increases surface temperatures with a consequent reduction in heating element life.

HEATER OUTPUT

$$\text{Actual output (watts)} = \text{rated output (watts)} \times \left(\frac{\text{actual volts}}{\text{rated volts}}\right)^2$$

VARIATION OF OUTPUT WITH VOLTAGE



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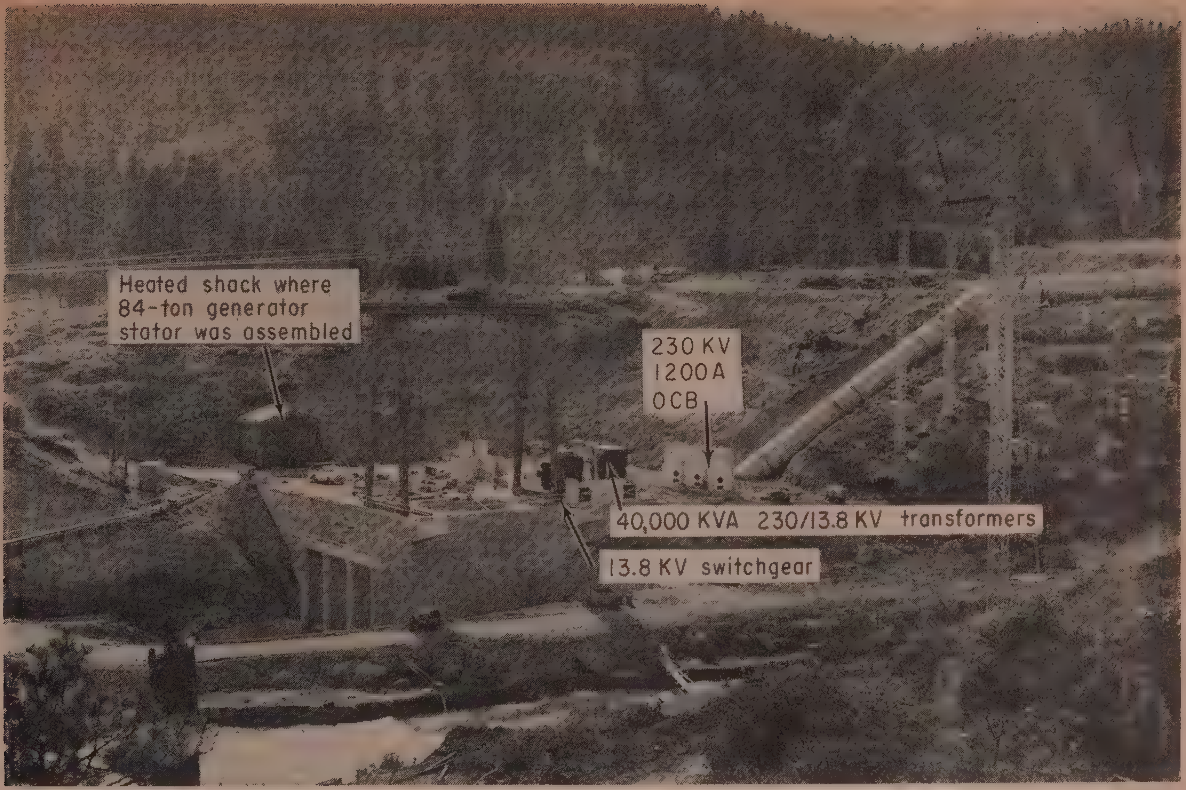

Heated shack where 84-ton generator stator was assembled
230 KV 1200A OCB
40,000 KVA 230/13.8 KV transformers
13.8 KV switchgear

TO MEET PROGRESS SCHEDULE, huge generator stator was assembled on temporary platform (enclosed by shack seen behind gantry) while concrete foundation work was being completed. Shack was electrically heated so as to neutralize weather variations and to preclude condensation forming during coil connecting.

Time-saving field methods were developed for the . . .

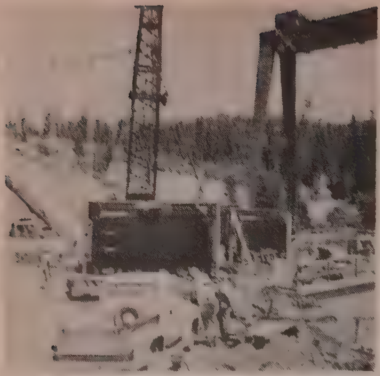
Remote Assembly of a 150-Ton Generator

Contractors Wismer and Becker of Sacramento, Calif. met a tight installation deadline by assembling a heavy generator stator in a remote location while its permanent concrete foundation was being formed.

UNUSUAL field problems related to heavy electrical construction are no novelty to contractors Ed Wismer and Hugo Becker of Sacramento, Calif. What to them is "all in a days work," however, is often "offbeat" by general criteria. Take for example their recent assignment in the rugged Feather River and Lassen volcano country, where they installed all turbines, generators, transformers and switchgear in a series of Pacific Gas & Electric Co. powerhouses, three of which were constructed during a single year. One of these three, located in remote Butt Valley, was particularly "interesting" because progress was hampered not only by snowstorms and distances from shipping terminals, but also by delays in delivery of materials and in completion of concrete foundation work.

In addition, some heavy items of equipment had to be trucked over mountainous dirt roads during unfavorable weather, transported by means of 24-wheel flat-bed trailers, then installed while spring thaws were converting frozen ground into mud.

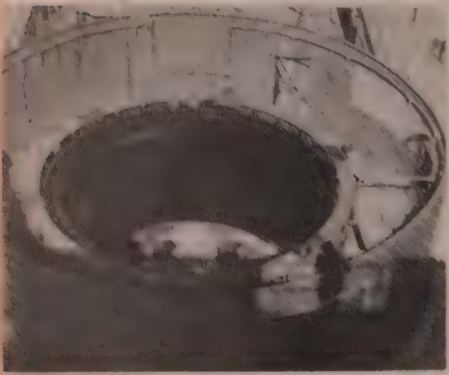
This truly was heavy construction, for generators and components at the Butt Valley installation weighed over 160 tons; turbines



MASSIVE STATOR for powerhouse generator was trucked to Butt Valley site in three sections. There components were shifted by crane to . . .

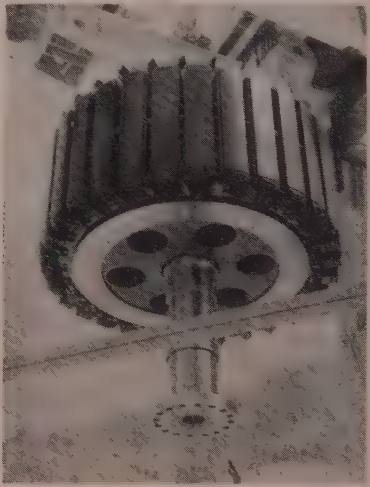
TEMPORARY PLATFORM which was enclosed by heated shack that permitted assembly work to continue unaffected by outside weather conditions. Then . . .

BEAM SKIDPATH was constructed between temporary and permanent foundations and drag cables were secured to platform. Short but tricky . . .



84-TON FRAME was lowered into place, aligned above turbine axis and (with upper bearing bracket removed), was exactly leveled. Meanwhile . . .

MASSIVE ROTOR was assembled on erection pedestal; keys were weight-balanced and installed: laminated faces were ground smooth. After that . . .



ROTOR WAS LIFTED by station gantry, shifted over center-line of previously installed stator frame, and eased down over keyed . . .

and components exceeded 150 tons; and transformers weighed over 90 tons. Most of these items were partially disassembled before shipment, yet even components created major trucking and handling problems, since each of three generator stator sections weighed 56,600 lbs; shaft and rotor center weighed 72,000 lbs, while upper bearing bracket with two arms removed weighed 45,000 lbs.

Due to the various problems, however, several interesting field solutions came into being, one of particular interest having to do with the assembly of the main 40,000-kva generator.

Remote Assembly of Stator

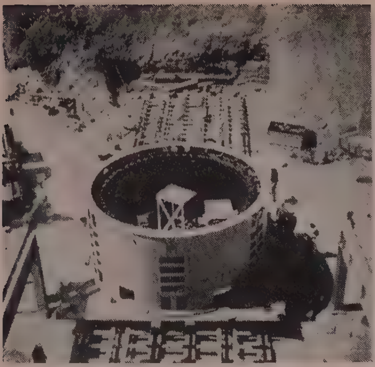
As mentioned, the stator frame had been delivered in three sections, each 28-ton segment being trucked to the powerhouse site seperately. Upon arrival at jobsite, however, foundation work was still in progress, and it was apparent that waiting for this preliminary work to be finished would jeopardize the "target date" of assembling the stator by normal procedures, that is, "in place."

For that reason it was decided to attempt the tricky task of assembling and winding the 84-ton stator at a spot slightly removed from the stator's permanent location (while the foundation was simultaneously being completed), then skidding the stator into place and lowering it into position after concrete work had been finished.

A suitable location for this assembly operation was formed by excavating a pocket in the shoulder of an adjacent mountain, then a temporary platform foundation was erected and a shelterhouse constructed over it.

This enclosure was heated through the medium of unit electric heaters and, by modifying climatic conditions in this manner, (1) possibility of expansion and contraction of parts was minimized, (2) stiffening and cracking of wire insulation was avoided, and (3) physical comfort for workers was provided.

In actual step-by-step progression, the three stator sections were crane-shifted into related positions on the temporary foundation. Split joints between sections were bolted together; then a platform scaffold was constructed inside the assembled frame for support of armature winders who installed jumper coils and completed connections between sections which (except for these final field operations) had been fac-



TRANSFER OF ASSEMBLED UNIT to permanent concrete foundation site was accomplished by this practical time-saving field method. Then . . .

STATOR WAS HOISTED from platform by gantry and shifted to permanent generator location. Note dowelled upper bearing bracket. Finally . . .

THRUST COLLAR that vertically coupled the 40,000-kva generator with the 52,000-hp reaction turbine aligned beneath it. Following this the . . .

UPPER BRACKET for rotor shaft was secured by bolts inserted in holes formerly occupied by dowels. Total weight of generator exceeded 150 tons.

tory-wound by the manufacturer prior to delivery.

In relation to this operation in general it may be added that, in making-up stator splits, coils were neither disturbed nor installed until they had been individually heated, thereby eliminating the danger of insulation failure due to cold bending. And, following pre-assembly practice, all components were thoroughly cleaned of slushing compounds and protective coatings which had been applied prior to shipment to prevent corrosion during the transportation period.

After the permanent concrete foundation for the stator had been completed, the lower bearing foundation cap was established at exact elevation and leveled, the lower bearing bracket was installed, and sole plates for the stator were positioned.

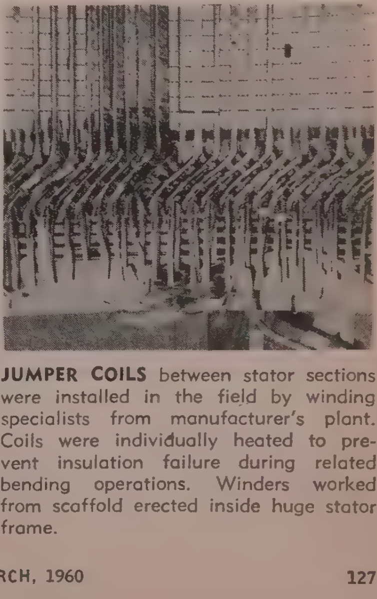
Skidding and lowering the king-sized pre-assembled stator into place began by constructing a suitable skidpath of 12- by 12-in. beams and crossmembers which were crane-jacked into position and bolted to form a path from the temporary assembly area to crane pick-up point. Winch-powered drag-cables were then secured to the temporary platform and the stator was slowly moved along the skidpath until it could be sling-attached to the station's gantry crane hook. It was then swung clear, inched into vertical alignment over the permanent bearing cap by means of tangential winching, then slowly lowered into position.

After this stator rim placement, field poles were hung and set to exact elevation; the stator was checked for level and elevation; the upper bearing bracket was centered on the stator, and the stator centered above turbine shaft beneath it.

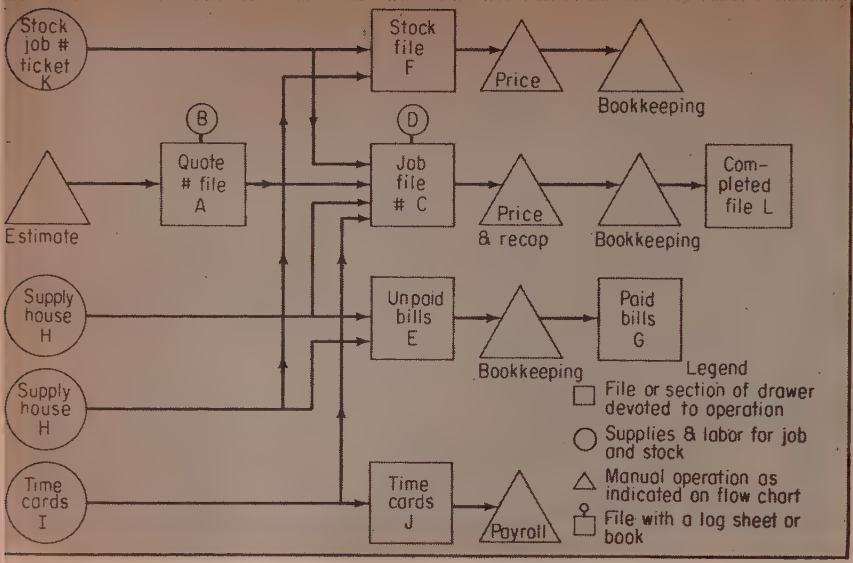
To complete the installation, the shaft containing the rotor hub was up-ended and placed on the erection plate. Rotor rim punchings were cleaned and, to insure perfect balance, rotor components were carefully stacked to distribute weight.

Temporary dowels were then inserted in bolt holes of the upper bracket (to insure exact replacement) and the bracket was removed to permit lowering of the rotor. After the upper bracket had been replaced and thrust bearing assembled, the thrust collar was placed on its shaft and load was carefully transferred to the bearing. Finally, rotor and turbine shafts were coupled, guide bearings were installed and the assembled unit was tested.

Since the complete Butt Valley electrical contract also included assembly and installation of (1) the complete hydraulic turbine, spiral case and runner assemblies, shafts and bearings, draft tube and supports, butterfly-type turbine shut-off and related control equipment; (2) the main 40-mva 230/13.8-kva transformer bank with related bus structures, OCB, lightning arrestors, disconnects, switchgear and cubicles; (3) a 250- and 25-ton gantry, plus (4) all indoor metal-enclosed electrically operated draw-out switchgear related to 120/208-volt station service; it may be concluded that W&B operations depart somewhat from the "norm" and reflect a high order of ingenuity.



JUMPER COILS between stator sections were installed in the field by winding specialists from manufacturer's plant. Coils were individually heated to prevent insulation failure during related bending operations. Winders worked from scaffold erected inside huge stator frame.



FLOW CHART SCHEMATIC details the steps necessary to install an accurate, complete and expandable record-keeping system. Index box in lower right hand corner defines flow chart symbols. (Fig. 1)

How to set up an . . .

Expandable Office System

The steps necessary to install a record-keeping system that is not only accurate and complete—but once it is put into operation and properly maintained can be expanded to satisfy any business growth rate.

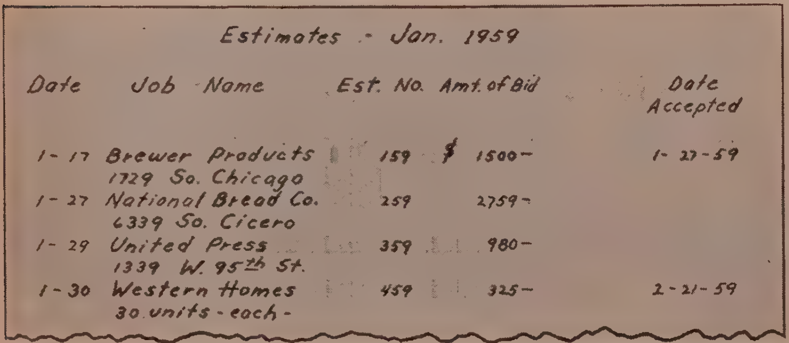
By **Irv Drucker**, *Drucker & Associates, Engineers, Chicago, Ill.*

THE SYSTEM illustrated and described in this article is designed so that one person can put it into operation. Only equipment necessary is a minimum of forms and a few file drawers. This method of record keeping covers every phase of a contractor's operation—from employees time to inventory control—besides enabling the contractor to determine quickly and efficiently the status of any job in progress. Another plus-value of the system is its ability to expand with the user's business growth rate.

The complete system is detailed in the flow chart schematic shown in Fig. 1. For further reference, the basic organization of the necessary office procedures is pointed out by letters. As we proceed with the description of the system we will refer to the flow chart and its letters.

Because much of the work accomplished by contractors is a direct result of estimates, it is important that a file be set up to contain these estimates (Fig. 1, A). This is one of the first steps necessary to put the system into operation. It is advisable that all estimates prepared for customers be numbered or indexed. The numbering method suggested for use with this system is to letter the first estimate of every year as 1 plus the year. For example, the first estimate prepared in 1959 would be numbered 159, and the 25th estimate prepared would appear as 2559. For quick reference, and to permanently record each estimate, including date submitted, customer's name, estimate number, amount of estimate and date accepted, a log sheet (Sheet 1) is placed in the front of the quote file (Fig. 1, B).

When an estimate becomes a job, the letter or copy of the quotation pertaining to the job is taken from the quote file, logged (date accepted entered on estimate log sheet), and placed in the jobs in progress file (Fig. 1, C). All information and data pertaining to the various jobs are funneled into the job file. Basically this file is set up in the same manner as the quote file. A job log sheet (Sheet 2) is maintained in the front of the file (Fig. 1, D) to record each job, including customer's name, date job was started, estimate number, job number, amount of estimate, and job completion date. All invoices, time sheets, material listings and other data for each job are separated in



Estimates - Jan. 1959

Date	Job Name	Est. No.	Amt. of Bid	Date Accepted
1-17	Brewer Products 1729 So. Chicago	159	$ 1500–	1-27-59
1-27	National Bread Co. 6339 So. Cicero	259	2759–	
1-29	United Press 1339 W. 95th St.	359	980–	
1-30	Western Homes 30 units - each -	459	325–	2-21-59

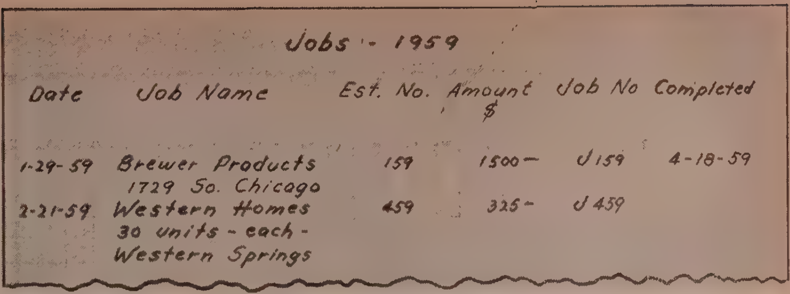
ESTIMATE LOG SHEET, placed in the front of quote file, serves as a permanent means of recording each estimate, including date submitted, customer's name, estimate number, amount of estimate and date of acceptance. The sheet also comes in handy for quick reference. (Sheet 1) the job file cabinet by file folders or large manila envelopes.

Material ordered for a job from a supply house is checked as soon as it arrives by matching each item on the shipping ticket against the actual material delivered. As invoices (requested in duplicate) are received on material purchased they are matched with previous checked shipping tickets. Then the duplicate invoices are split. One copy is placed in the job file, and the other copy goes into the unpaid bill file (Fig. 1, E). Invoices on material purchased for stock (also requested in duplicate) are checked against shipping tickets, then one copy of the invoice is placed in the material stock file (Fig. 1, F), and the second copy is placed in the unpaid bill file. This method keeps all unpaid bills together for bookkeeping purposes and also directs material charges to stock or to jobs. When the bills are paid they are transferred to the Bills Paid file (Fig. 1, G).

When material is taken from stock (Fig. 1, K) for a particular job it is written up on a material-out list (Sheet 3) in duplicate—one copy of the list is placed in the specific job folder in the main job file, and the second copy is put in the material stock file. By subtracting the total amount of material shipped out from the total amount of material purchased, the person in charge is able to arrive at the inventory net value in cost. This net cost provides control in terms of the amount of material (dollar value) that the contractor wishes to carry in stock.

Material returned for credit is entered the same as material charged out except that the sheets are stamped or marked credit or returned for credit. This is done in order that the person doing the recap can easily identify the items as a credit and make the necessary adjustments. It is advisable to have the material sheets used for credits a different color than material-out sheets.

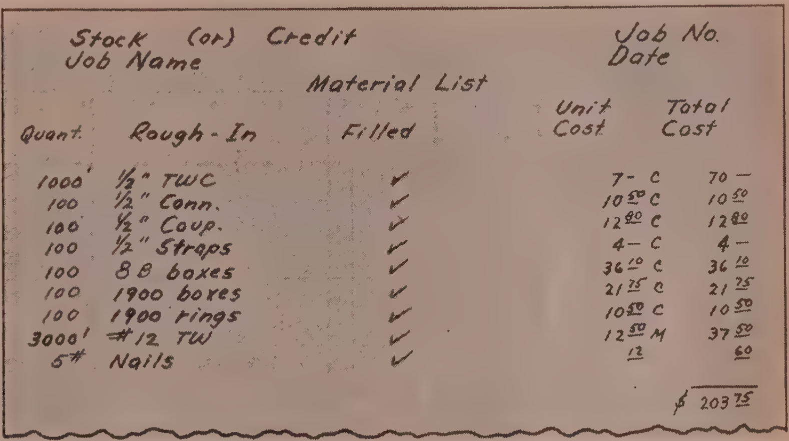
When time cards are sent in from men in the field (Fig. 1, I) they are checked, and the time is entered on labor log sheets (Sheet 4), which are kept in each job's folder in the job file cabinet. The sample shown indicates how time is entered for journeymen or apprentices. After the time cards are checked and entered on the various log sheets, they are stored in a file which is set aside for this purpose (Fig. 1, J).



Jobs - 1959

Date	Job Name	Est. No.	Amount $	Job No	Completed
1-29-59	Brewer Products 1729 So. Chicago	159	1500—	J159	4-18-59
2-21-59	Western Homes 30 units - each - Western Springs	459	325—	J 459	

JOB LOG SHEET is maintained in the front of the job file to record each job, including customer's name, date job started, estimate number, job number, amount of estimate, and job completion date. (Sheet 2)

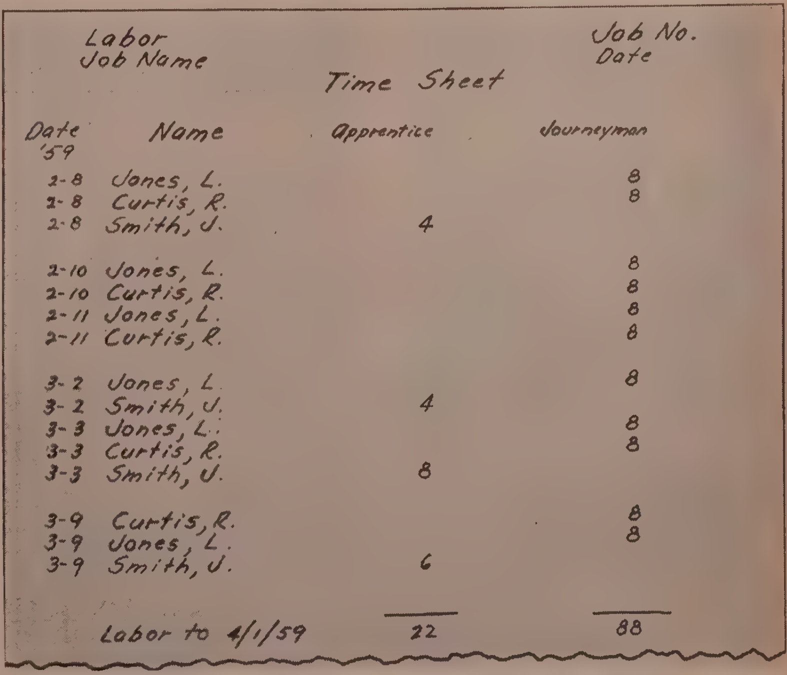


Stock (or) Credit
Job Name
Job No.
Date

Material List

Quant.	Rough - In	Filled	Unit Cost	Total Cost
1000'	½" TWC	✓	7- C	70 —
100	½" Conn.	✓	10^{50} C	10^{50}
100	½" Coup.	✓	12^{80} C	12^{80}
100	½" Straps	✓	4— C	4 —
100	88 boxes	✓	36^{10} C	36^{10}
100	1900 boxes	✓	21^{75} C	21^{75}
100	1900 rings	✓	10^{50} C	10^{50}
3000'	#12 TW	✓	12^{50} M	37^{50}
5#	Nails	✓	^{12}	^{60}
				\$ 203^{75}

MATERIALS-OUT SHEET is used to record material sent out to jobs from stock. The sheets are filled out in duplicate. One copy is placed in the specific job folder contained in the main job file, and the second copy is put in the material stock file. These same sheets are also used to record material returned, except that each sheet is clearly marked "credit". (Sheet 3)



Labor
Job Name
Job No.
Date

Time Sheet

Date '59	Name	Apprentice	Journeyman
2-8	Jones, L.		8
2-8	Curtis, R.		8
2-8	Smith, J.	4	
2-10	Jones, L.		8
2-10	Curtis, R.		8
2-11	Jones, L.		8
2-11	Curtis, R.		8
3-2	Jones, L.		8
3-2	Smith, J.	4	
3-3	Jones, L.		8
3-3	Curtis, R.		8
3-3	Smith, J.	8	
3-9	Curtis, R.		8
3-9	Jones, L.		8
3-9	Smith, J.	6	
	Labor to 4/1/59	22	88

LABOR LOG SHEETS, recording workmen's time in the field, are kept on every job. When the job is completed the sheets are used to compare the total actual amount of labor against the total estimated amount of labor. (Sheet 4)

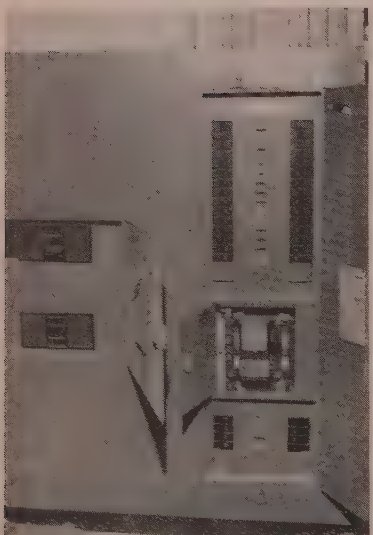
HEADQUARTERS BUILDING is a one-level industrial-type structure with a warehouse-garage in front and office area in the rear. Building was completely modernized. Service can be seen at front corner of building.

New Jersey Contractor says:

"My Shop Is My Show

Here's how one electrical contractor has lighted his new headquarters office to a maintained intensity of 150 footcandles—to show his clients the kind of lighting he wants to sell them.

By **Arthur L. Davis,** *President, A. L. Davis Company, Electrical Contractors & Engineers, Newark, N. J.*



SERVICE PANEL at front corner of warehouse area consists of two enclosures coupled together. The 200-amp main CB and a 150-amp CB for A/C feeder are at left. The 120/240-volt panel is at right with the remote-control contactor shown in the split-bus layout. The 120-volt control circuit for the contactor uses No. 14 wires, fused at 6 amps. Fusing of the control circuit is required by section 725-18 of the NE Code, which would allow that conductors as small as No. 18 be used in this case—protected at not more than 20 amps.

IN SELLING modern lighting, there's nothing like showing "the product" to the customer. And there's no better or more convenient place to have "the product" than right in your own office. That was the thinking behind design of my recently finished headquarters building.

Our new shop is a modernized one-level building, with a warehouse-garage in the front and a large office area in the rear. Before we moved in here from our old shop, we had to renovate and redesign the complete interior. After stripping the building practically to a shell, we had the interior partitioned to meet our operating requirements. From that point the rewiring and lighting work went forward.

Calculated electrical demand plus considerable spare capacity for load growth called for 200-amp rating in the 3-phase, 4-wire, "red leg" delta service (fourth wire is a grounded center tap from one phase). The 3-phase load consists of the air conditioning unit. The 120/240-volt single-phase is used for lighting and convenience outlets.

The circuit to the air conditioner load and all branch circuits originate at the circuit-breaker service and distribution panelboards in the front corner of our building. As shown in an accompanying photo, the 120/240-volt, 3-wire panel is a split-bus type with a 60-amp, 2-pole, remote-control, mechanically-held, single-coil, magnetic contactor between the bus sections to provide ON-OFF control of eight circuits used for fluorescent lighting in the main office area.

Lighting is the big thing we concentrated on. We wanted a lighting job which we could show to our clients—architects, builders and owners—to demonstrate the appearance and advantages of modern lighting. In particular, such a "show-window" lighting installation would help us in selling to the executives of banks and to office and school management people, with whom we do a large volume of business.

To meet the need, we set out to produce a high-intensity lighting result with a high order of visual comfort and good efficiency in the application. As shown, we achieved our objectives with a maintained lighting intensity of 150 footcandles (down from an initial level of

LIGHTING RESULT in engineering office area includes a maintained level of 150 footcandles, with low fixture brightness and excellent diffusion for uniformity of lighting level.

Window"

PRIVATE OFFICE lighting layout combines a recessed, 4-lamp, dimmer-controlled fluorescent luminaire over the desk with a number of strategically-placed recessed incandescent lensed hi-hats. The incandescent units are dimmer controlled and are controlled individually by low-voltage relay switching to provide varying light effects. Control switches for dimmer and relay circuits are mounted alongside the desk, as shown in photo above.

200 footcandles). And the comfort conditioning due to excellent diffusion and shielding is a notable feature of this installation.

The main office area is lighted by four continuous rows of 4-lamp, lensed-fluorescent luminaires surface mounted on the 9-ft 6-in. high ceiling. The rows are mounted on 6-ft centers, with the center line of each end row 3 ft from the wall. The basic luminaire contains four, 40-watt, rapid-start, warm-white fluorescent lamps and is 4 ft long. Diffusion and shielding are provided by a plastic lens.

With the exception of three luminaires near the door, in the first row, office area lighting is circuited through the magnetic contactor at the service panel. A single-pole, single-throw toggle switch, wall-mounted at the main entrance, operates the contactor for ON-OFF control of the general lighting. The three luminaires near the door are directly controlled by a standard wall switch to provide entrance lighting without using all lights.

To top-off the general office lighting, we designed a modern lighting treatment in my private office. As shown in a photo, this includes a recessed lensed fluorescent unit over my desk and some lensed high-hats. Control includes low-voltage relay switching and a dimmer for the fluorescent units. The system provides quantity and quality of light with control flexibility to meet the visual and decorative requirements.

Already, our investment in this "show-window" layout has returned dividends. And we expect the dividends to grow rapidly as the trend to high intensities gains acceptance.

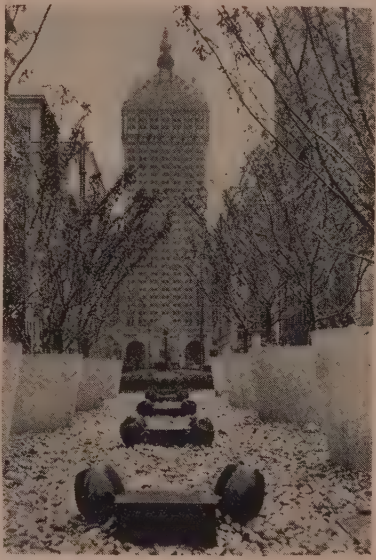
CONVENIENCE OUTLETS in office partitions are wired with armored cable on circuit leg tapped from wall surface receptacle box. Connection from wall circuit box to partition is in EMT, as shown. Where circuit crosses doorways in partitions, the floor was channeled to bury EMT. crossovers under the floor tiles. Telephone conduits are similarly buried at doorways.

Mercury Floodlighting

Beautifies Famous Street

GREENISH-BLUE light from mercury vapor lamps create fairyland luminous effect on specially-planted trees in mall areas of New York's Park Avenue, a contribution to the city's annual "Salute to the Seasons."

Special mercury floodlight units light trees and shrubbery on New York's famous Park Avenue. Installation was contributed as tribute to City's annual "Salute to the Seasons."



FLOODLIGHTS are located in center of mall area of Park Avenue, and contain 100-watt clear mercury vapor reflector lamps. Transformers for lamps are housed in large cast aluminum boxes to which floodlights are attached.

MERCURY floodlighting has been used to dramatically light a special planting of trees on New York City's famed Park Avenue. The installation extends along three blocks of this traditionally renowned thoroughfare, on the center malls that divide the north and south traffic lanes of the street, between 49th and 52nd streets. The project represents a special contribution to the City's annual "Salute to the Seasons," a municipal program that encourages private companies to beautify their metropolitan properties through plantings and illumination.

The trees are floodlighted by a total of 64 100-watt mercury vapor lamps, mounted in clusters of four along the center of the mall and just above ground level. Each cluster of four units is mounted on a cast aluminum transformer box, which is installed on a precast concrete base buried beneath the surface of the planting area. A layer of gravel covers the surface to a point about 2 in. below the lamp housings. Both the lighting units and the transformer boxes are weatherproof.

The consultants who planned this project faced some unusual problems. Tracks of the New York Central railroad, and a whole network of conduits of various types, run directly beneath the surface of Park Avenue along this 3-block area. Trees therefore had to be planted in large concrete urns. Also, these malls were supplied electric power by single-phase, two-wire, 110-volt circuits only, which were insufficient for the new mercury lighting load. The local electric utility provided additional capacity by the addition of a third wire, and conversion to a 120/208-volt system. This electrical service was terminated in three cast metal service entrance boxes, one in each of the three mall areas, and installed above ground level. No. 12 branch circuits were then run from these service entrance boxes to the transformer boxes in rigid steel conduit, and subsequently to the individual floodlight units from the mercury lamp transformer secondaries.

The 100-watt mercury lamps are mounted in cast aluminum floodlight housings, each containing a special heat-resisting glass lens and a parallel-vane louver. Units are pointed upwards at the tree branches and foliage at angles varying from 30 to 45 degrees from vertical. This adjustment flexibility is made possible by swivel bases built into the equipment. This permits individual adjustment of each unit for maximum light distribution utilization and for proper shielding. Provisions are also made for the addition of color filters to vary the decorative lighting effects, if later desired.

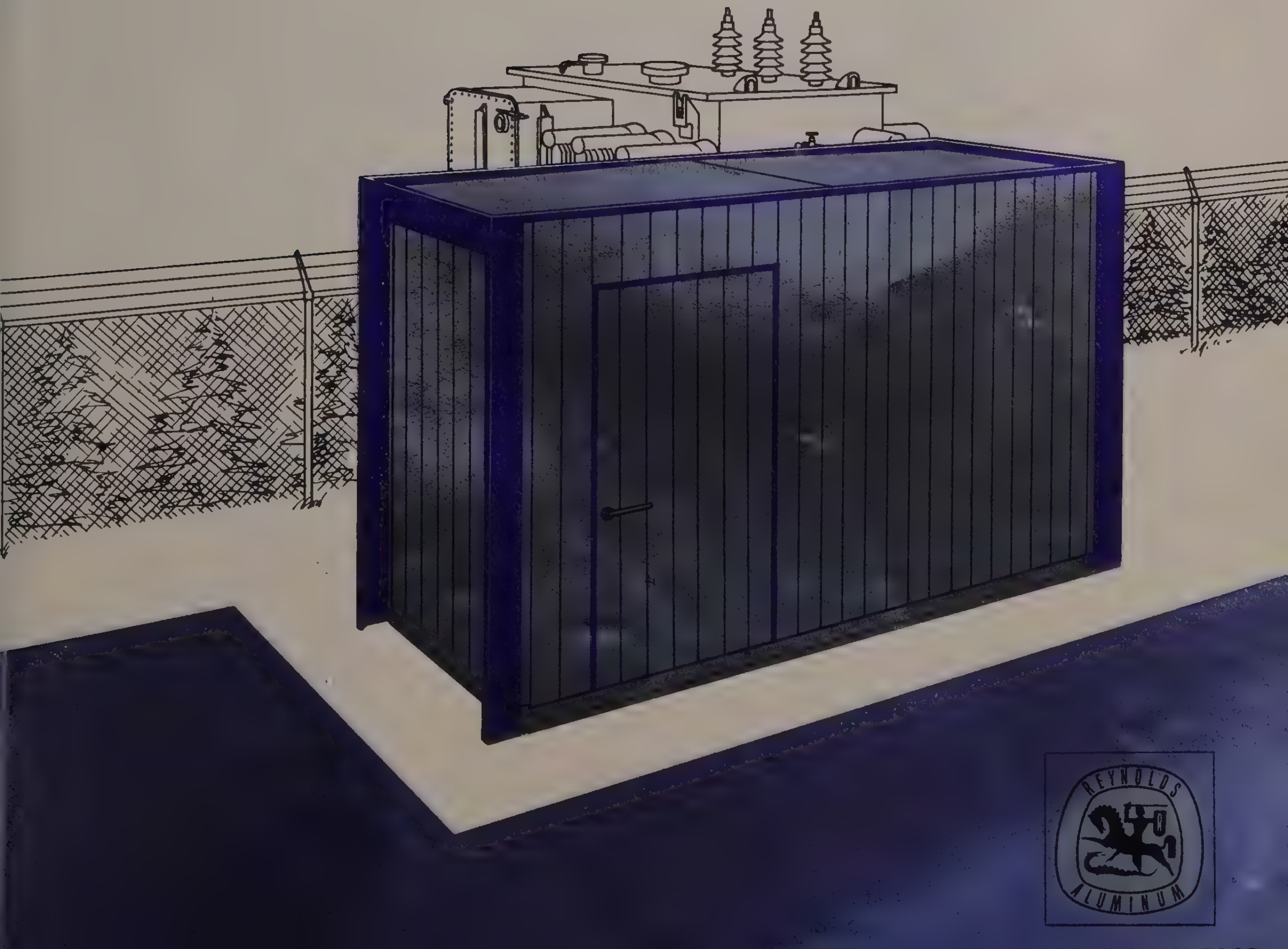
The characteristic blue-green quality of the clear mercury lamps, non-color corrected, has been found to be most appropriate for the lighting of the green tree leaves and for creating a most attractive and decorative luminous effect at night.

This project was sponsored by Uris Brothers, New York building firm, and builders of several of New York City's newest skyscrapers. Consulting electrical engineers were Joseph R. Loring Associates, and the electrical contractor was the Arc Electric Company. The floodlights and transformer housings were made by the Simes Company, New York.

NEW ALUMINUM SUBSTATION UNITS

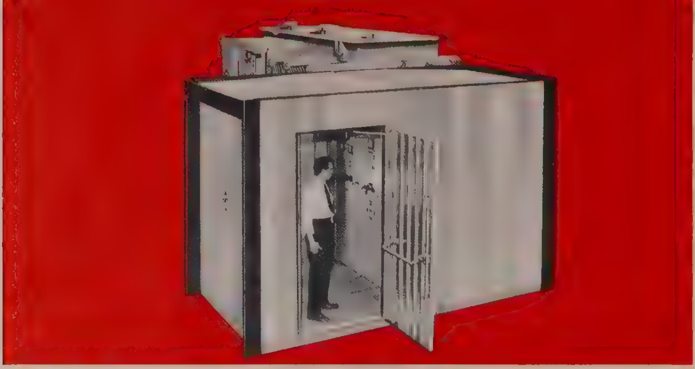
—developed by Allis-Chalmers with Reynolds Aluminum—

OFFER LOWER MAINTENANCE,
CORROSION-RESISTANCE,
ATTRACTIVE APPEARANCE



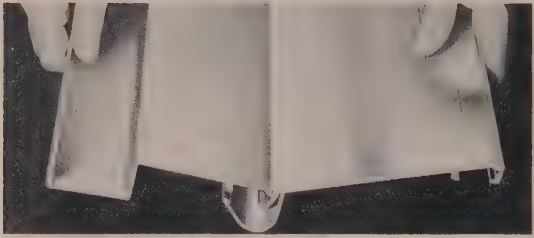
REYNOLDS ALUMINUM

PLEASE TURN PAGE . . .



Lasting Beauty
Your Community Will Be Proud of—
Allis-Chalmers Aluminum-Clad
Substation Units

Use of Aluminum in Substations Adds New Economy, Long-Range Savings in Electrical Installations



Panels for Aluma-Clad switchgear housing snap together so that joints between them are water tight. Extruded aluminum panels interlock to form reinforced sections.

Bolted-on rear panel sections are easily removed by *one man* without use of a crane. Each switchgear cubicle can be inspected individually. Ventilation in this region is increased by using the labyrinth cross-section of the aluminum extrusions to pass filtered air up through the bottom and out the top. This increased cooling of the bus compartment keeps the operating temperature within maximum limits even during peak load periods on hot days.

Developed by Allis-Chalmers and Reynolds engineers, this new aluminum substation unit offers many important advantages in electrical installations. Extruded aluminum sections that interlock to form structurally reinforced panels are used in construction to reduce labor costs, provide strength and rigidity. The station flooring also utilizes aluminum sections that interlock to provide a neat, clean installation.

Aluminum will never rust, therefore these units will never need protective painting. They'll resist corrosion in salt air and contaminated atmospheres.

The bright natural sheen of aluminum is a lasting one, too. That means these aluminum-clad substations will add real beauty to your installation, beauty that lasts.

And because aluminum is lighter in weight, shipping and installation costs can be lower. Roof-top installations, especially, can be simpler, less expensive with the new Allis-Chalmers switchgear units.

Allis-Chalmers new aluminum-clad outdoor substation units are an important engineering achievement in electrical equipment design—an achievement which means lower costs, more lasting beauty for utility and industrial substation installations. Reynolds is proud to have played a role in this important development, providing both aluminum and aluminum know-how. For details on any electrical equipment using aluminum enclosures, contact your nearest Reynolds Sales Office or write *Reynolds Metals Company, Richmond 18, Virginia.*

REYNOLDS ALUMINUM

Watch Reynolds TV shows—**"ALL STAR GOLF," "BOURBON STREET BEAT,"** and **"ADVENTURES IN PARADISE"—ABC-TV**

MV Lamps Aid Bank Relighting

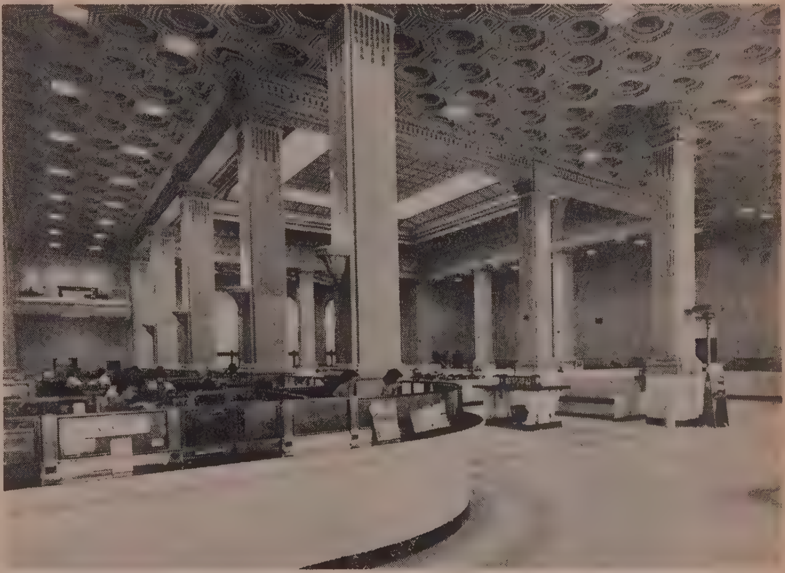
San Francisco bank relighting combines color-corrected mercury-vapor downlight with incandescent uplighting and fluorescent skylight treatment to raise formerly existing illumination levels by 500%.

UTILIZING mercury vapor to illuminate high-ceilinged commercial interiors is a relatively new lighting concept. Yet, with the advent of color-corrected m-v lamps, this high-output source can provide pleasing results with reasonable brightness ratios and gratifying economic advantages when combined with fluorescent and incandescent lamps.

This combination was demonstrated in the Crocker-Anglo Bank, San Francisco, where the three lighting sources were blended together in a relighting plan. And, coincidentally, this installation won for the designers the Charles Goddard Class II trophy for 1959, signifying that this project was rated by the IES last year as having top interest in the non-residential field.

This lighting assignment had several interesting problems, for (1) ceiling heights in this interior varied between 12 and 35 ft, (2) the ceiling plan was irregular in shape, (3) Renaissance architectural features which could not be altered included fluted columns and rococo ceiling coffers, (4) access to mercury fixtures, once installed, would be inconvenient for relamping purposes, and (5) lighting intensities were to be increased in the order of 500% without disturbing the turn-of-the-century decor which was to be maintained in spite of a modernization emphasis.

Segregating the installation into its three light-source components, (a) *mercury vapor* lamps and prismatic glass lenses are recessed above executive bays and public areas to illuminate desk tops and teller counters; (b) *incandescent* clusters of R and PAR lamps are concealed in up-turned column-mounted urns, in free-standing ornamental torchieres and over entrance vestibules to emphasize architectural details of the sculptured ceiling, columns and capitals; and (c) *fluorescent* low-brightness panel patterns are used to define limits of a high-bay (35 ft) central skylight and also to provide high-intensity shielded illumination in two low-ceilinged (12 ft) general office, clerical and filing sections.



RENAISSANCE ARCHITECTURE of this strikingly ornate interior included sculptured ceiling coffers, fluted columns and ornamental urns, all of these beautiful features being retained and emphasized by skillful combination of mercury-vapor, incandescent and fluorescent lighting applications.

Color-Corrected Mercury Downlight

Since the 400-watt high-bay mercury fixtures replace a series of recessed 500-watt incandescent units that projected their lightbeams through small square apertures, it was first necessary to enlarge original openings, then to construct ornamental shielding louvers which were designed and painted in matte finish to blend with the coffer motif.

MERCURY VAPOR color-corrected lamps and prismatic glass reflectors are shielded by ornamental square louver assemblies designed and finished to blend with details of surrounding rococo ceiling coffers. Use of 7000-hour JH-1-X lamps is major maintenance plus-value, since relamping is necessary only on 3-year cycle.

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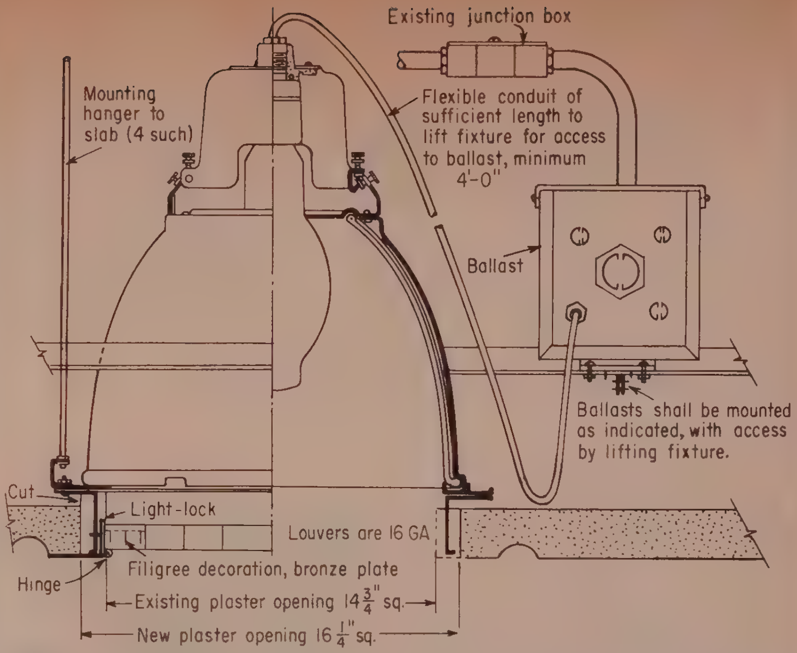
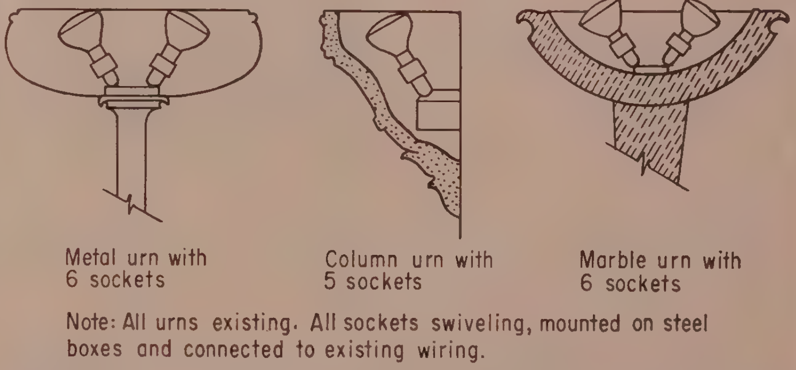

Existing junction box
Mounting hanger to slab (4 such)
Flexible conduit of sufficient length to lift fixture for access to ballast, minimum 4'-0"
Ballast
Ballasts shall be mounted as indicated, with access by lifting fixture.
Cut
Light-lock
Louvers are 16 GA
Hinge
Filigree decoration, bronze plate
Existing plaster opening $14\frac{3}{4}$" sq.
New plaster opening $16\frac{1}{4}$" sq.

HIGH-BAY MERCURY FIXTURES are independently supported by rod hangers secured to overhead slab, while related ballasts are mounted to angle truss structure. Connection of luminaire and ballast by long flexible cable permits unhampered movement of fixture to gain access to ballast. Use of mercury units boosted light output by 460% while reducing current consumption by 6½%.


Metal urn with 6 sockets
Column urn with 5 sockets
Marble urn with 6 sockets
Note: All urns existing. All sockets swiveling, mounted on steel boxes and connected to existing wiring.

EXISTING COLUMN URNS and ornamental torchieres were equipped with steel mounting boxes and swiveling sockets for series of upturned reflector incandescent lamps for purpose of highlighting formerly unnoticed details of contoured ceiling.

Louver panels, provided with hinges and light-locks on one edge and holding latches on the other, are swung down for relamping; a routine chore which is performed, when required, from scaffolding.

For this reason, the use of JH-1-X lamps returned a triple dividend, for (1) the rated 7000-hr lamp life of the mercury lamp, results in an approximate 3-year interval between relamping as compared with a 4-month interval for incandescent, offers a definite maintenance value, (2) obtained footcandle intensities at desk level of 70, as compared with 15 fc formerly provided by the incandescent sources, offers a 460% boost in illumination with reasonable brightness values which are measured at 1000 ft lamberts at 60 degrees. (3) and power consumption, including ballast losses, of 4.2 w/sf, as compared with former consumption of 4.5 w/sf, offers an acceptable 6½% saving.

Since new and old placement patterns are identical and since wattage per sq ft is now less, no wiring changes were necessary.

As noted in the closeup view of this mercury unit, louvers consist of 1-in.-deep 16-gauge fins arranged as concentric squares on 1⅝-in. intervals, outer gaps being additionally decorated by ornamental filigrees.

Above the cast-plaster ceiling, high-bay lensed fixtures are sup-

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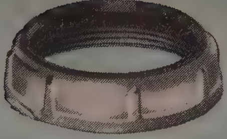

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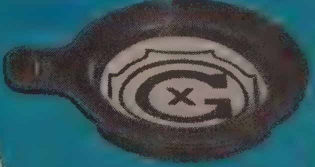

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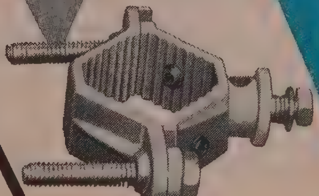

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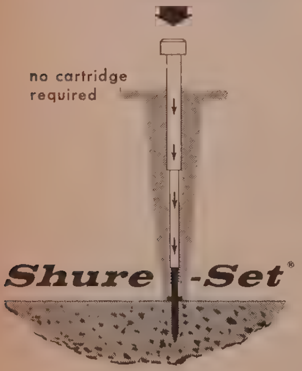

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RECESSED SLIMLINE UNITS were mounted side-by-side in continuous arrangement to obtain effect of outlined skylight. Removable top covers of fixtures permit cleaning and relamping from bordering catwalk. Total of 176 warm white 6-ft fluorescent lamps were used in installation to boost illumination in this central area from 10 to 80 footcandles.

ported independently by rod hangers embedded in the overhead slab, while related ballasts are mounted by bolted plates to an angle truss structure. Ballasts are then connected to existing junction boxes by thinwall conduit; fixtures are attached to ballasts by flexible leads; and leads are liberally dimensioned at 4 ft to permit displacement of fixtures for access to ballasts if necessary.

Incandescent Up-Lighting

Due to deep recesses in molded ceiling coffers, the additional installation of up-lighting by incandescent units illuminate formerly unnoticed architectural details and coloring of the lofty interior.

To provide this up-lighting component, existing ornamental column urns and pedestal torchieres were fitted with steel mounting boxes and swiveling sockets; five 150-watt R-lamps were enclosed in each urn, six in each torchiere. In addition, a dozen R-40s (six 150s and six 300s) are similarly mounted on, and shielded by, a canopy above one of the side entrances to provide additional illumination (and lessen contrast ratios of) the sculptured ceiling.

Treatment of the large central "skylight" court actually restores the "original" look to this section, for this skylight had been blacked-out at the beginning of the second World War and a fluorescent-back-lighted louvered ceiling had been installed at that time to provide an average footcandle level of 10 on desk tops beneath it.

The present installation raises

this level to 80, and it also redefines the outline of the initial architectural concept. This was accomplished by installing a 6-ft-wide recessed troffer to outline the 33- by 45-ft rectangle, coordinating edge-details of the troffer with existing architectural paneling and utilizing plastic lenses to obtain diffuse illumination with a relatively low brightness value of 300-ft lamberts as measured from a 60-degree angle. In this installation, a total of 44 3- by 6-ft 4-lamp fixtures are mounted side-by-side, 176 warm-white 72-in. T-12 slimlines thereby being used to illuminate an area of 3800 sq ft.

Due to the existence of accessible space above the skylight section, these fixtures may be relamped from overhead catwalks, removable fixture tops (with handles and locking wingnuts) being installed for that purpose.

As to wiring, 4-lamp fixtures are separately connected by flexible conduit to a series of 2-fixture junction boxes positioned along catwalks, JBs then being connected together and to the attic distribution panel by rigid conduit, and a contactor installed to permit remote control of the installation from two locations (adjacent to entrances) on the main floor. As in the case of the mercury-vapor downlights, the fluorescent skylight installation is controlled through a contactor remotely activated by main-floor switches.

Fluorescent treatments were also adopted to illuminate two additional low-ceilinged office areas that flank the main public section of the bank, this second treatment utilizing 4- by 4-ft recessed 6-lamp troffers equipped with low-brightness plastic lenses and supported by corner rods anchored to the overhead slab. Around these square fluorescent units, acoustical panels are supported independently by runner channels positioned on 4-ft centers. In this installation, fixtures are grouped in fives for branch-circuiting purposes.

By approving this combination of mercury-vapor downlights, incandescent up-lighting and fluorescent paneling, Crocker-Anglo officers have obtained light values well above their expectations. And these three different light sources have been so applied that the traditional elegance of this classical Renaissance interior has been enhanced, for higher lighting values now reveal architectural details that were unnoticed and unappreciated with existing inadequate illumination.

Credit for the installation belongs

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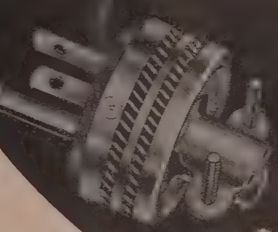

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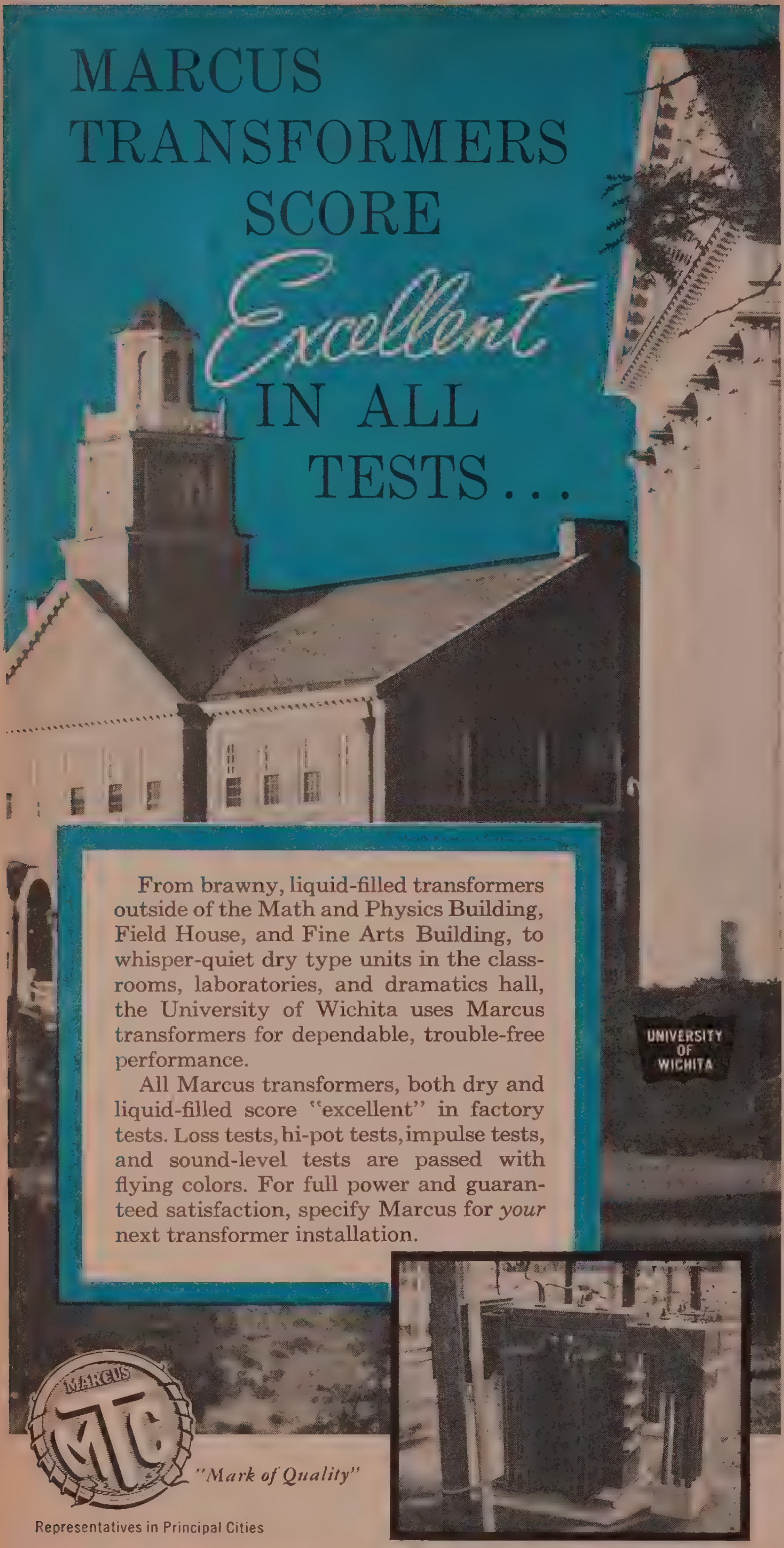

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to Milton T. Pflueger, architect; Lloyd Dehrer, chief electrical engineer for the West Coast consulting firm of Buonaccorsi and Murray; and to the Charles A. Langlais Co., electrical contractors responsible for the installation. Likewise pertinent is the fact that the installation was performed completely outside of normal banking hours. And, since all portable scaffolding was removed after completion of each night's work, the lighting modernization involved no disruption of business or inconvenience to the public during the day.

Lightweight High-Voltage Cable Results In Labor Saving

Two West Coast joint-venture electrical firms, Pacific Electric & Mechanical Co. of San Francisco, and Rosendin Electric of San Jose, recently installed over five miles of high-voltage aluminum cable at a Navy missile ordnance plant in Sunnyvale, Calif., the longest pull being one of 1085 ft between a rectifier station and manhole. The installation, one of the largest high-voltage projects noted to date in western industry, also included switchgear terminals of compatible metal.

In this process, 500MCM power

THREE 500MCM CONDUCTORS are fed into manhole by single man at U. S. west-coast Naval Ordnance plant, indicating handling ease related to high-voltage aluminum cable. Note square roller-rig protecting cable insulation from scraping against manhole sill. Cable reels were shifted as necessary by fork-lift.

ADHESIVE was applied to tee-splice during installation of 12-kv ungrounded-neutral feeder circuit serving Naval missile plant. System was handled by Pacific Electric & Mechanical Co. of San Francisco and Rosendin Electric Co. of San Jose under joint-venture contract.

ALUMINUM CABLE SPLICES, hung on temporary supports, were protected with ozone-resisting neoprene tape, additional serving of friction tape and final coating of weatherproof paint.

cable splices were protected with ozone-resisting neoprene tape, with a final serve of friction tape plus coatings of weatherproof paint.

According to contractor Ray Rosendin, the relatively lightweight cables had little friction drag, while easier handling and installation resulted in a man-hour saving of about 12%. Cables, delivered to jobsite on 5-ft reels, were moved as required by small fork-lift trucks.

Main feeders on the project consisted of 750MCM, while over 26,500 ft of 500MCM power cable was used to complete the installation. Cables were butyl-insulated aluminum-shielded neoprene-sheathed having a low dc insulation leakage value below 0.06 micro-amperes at 40-kv.

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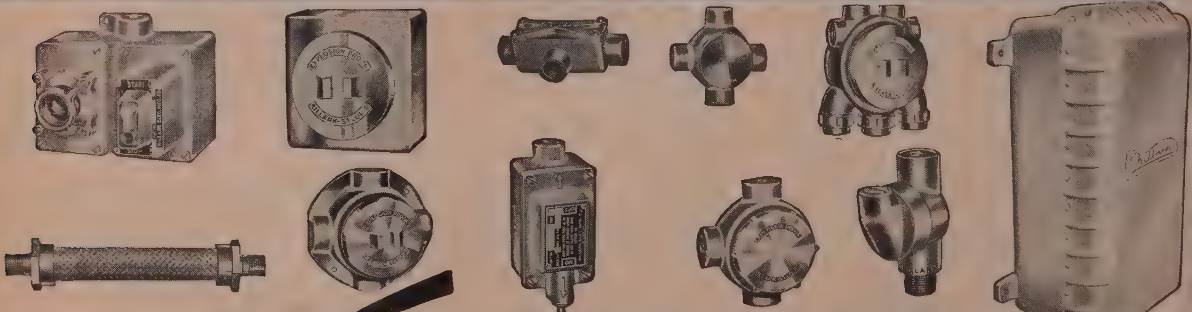
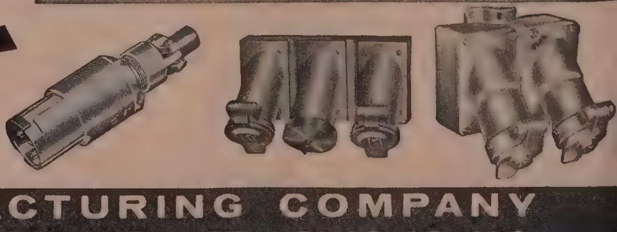


PLUGS & RECEPTACLES



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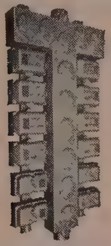
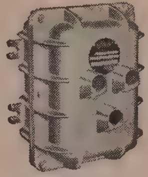
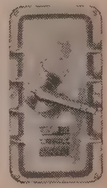

PANEL BOARDS

CIRCUIT BREAKERS


MOTOR STARTERS

DISCONNECT SWITCHES


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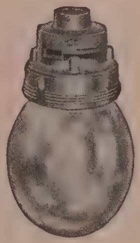
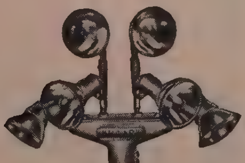


LIGHTING FIXTURES—SPECIAL LOCATIONS



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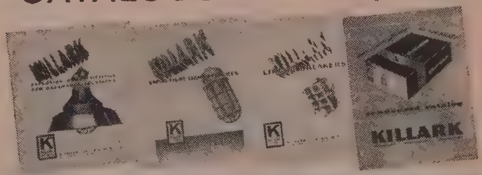

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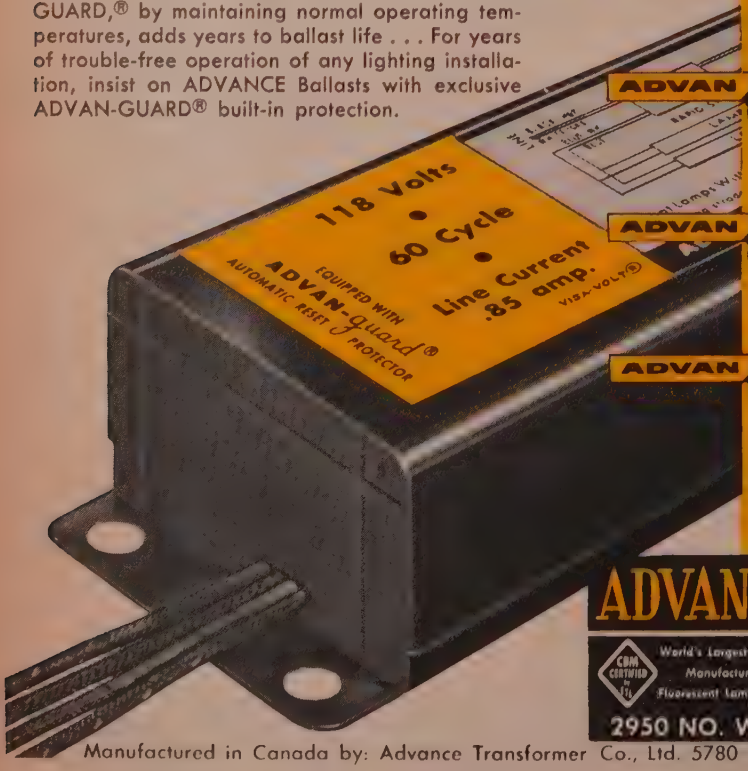

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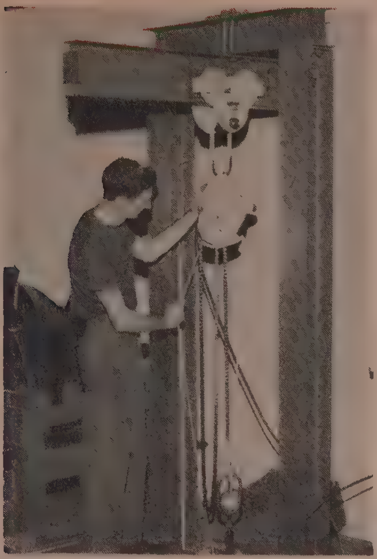
Load Test Checks Out Hoist Repairs

Whitney Electric Co., Toledo, Ohio, motor service shop, develops adjustable-weight device to test hoist motors under field conditions.



LOAD-TESTING a ¼-ton electric hoist at the Whitney shop. Chain goes through floor trap to test weights below.

I-BEAM UPRIGHTS on first floor form track for test weights; support hoist trolley on floor above.

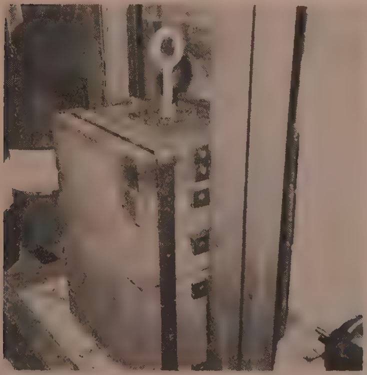
INCREASED use of electric hoists in industry has created a substantial service and repair market for this type of equipment. Numerous motor repair shops throughout the country are enjoying this added business; many have become manufacturers' authorized service centers. Among them is Whitney Electric Co., a Toledo, Ohio firm that is constantly striving to improve customer service.

Equipment testing facilities comprise one of its important service features. Before any repair job leaves the shop, Whitney management requires that it be given a thorough check-out or test under simulated field conditions. Recognizing the different and comparatively specialized approach to hoist service, Whitney established a separate department in its second-floor shop complete with repair bench, special tools, test equipment and a substantial stock of replacement parts of all types.

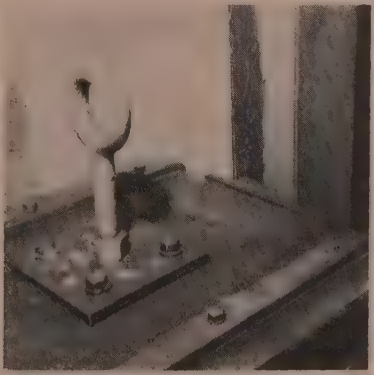
To check a hoist's lifting power and general operation under field conditions, Whitney personnel constructed an adjustable-weight test device to cover units from ⅛-ton through 2-ton rated capacity (including 20% overload). Weights are raised and lowered on a steel "track" extending to the first floor level. Two 6-in. steel I-beam uprights, mounted about 2 ft apart on a sturdy concrete base, form this track; are extended up through the second floor; terminate in an I-beam cross-piece which supports a hoist rail. The hoist under test is suspended from the rail trolley and its lifting hook is lowered through a floor trap door for connection to the weights below.

Use Multiple Weight Blocks

Load weights rest on a sand cushion at the base of the uprights. The 55-in. by 38-in. pit is formed by a 9-in.-high concrete curb en-



TEST WEIGHTS consist of five cast-iron blocks dimensioned according to allotted weight. Bolt-strap assembly permits flexible combination of blocks to attain required test loads.



GUIDE BRACKETS bolted to each weight block ride I-beam flanges; prevent load sway during test. Sturdy lifting bolt on top block connects to chain dropped through floor trap.

WORK BENCH for hoist repairs has array of special tools on handy peg-board rack, jar storage for small parts and test panel for single- and 3-phase 220-volt and 110-volt single phase equipment.

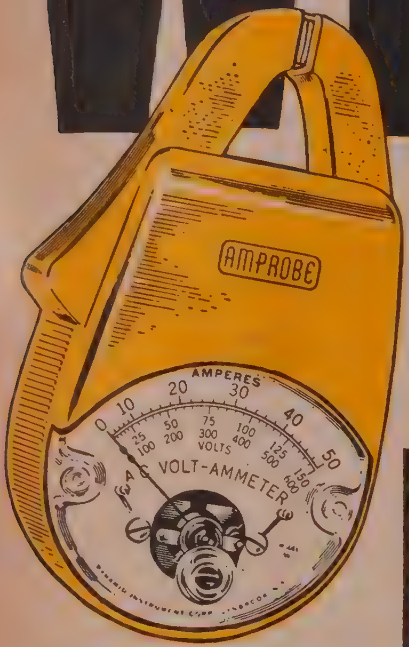
PARTS BINS and drawers in stock room hold large variety of replacement items and accessories for electric hoist service.

circling the I-beams. A total of five 24-in. by 24-in. cast iron blocks constitute the weight assembly. Block thickness is graduated according to test weight (including 20% overload) for specific hoist rated capacities. A 2-in. block weighs 300 lbs (⅛ ton). There are two of these.

A 4-in. block weighs 600 lbs (¼-ton hoist); 8-in. block, 1,200 lbs (½-ton); 16-in. block, 2,400 lbs (1-ton). Weights are stacked with the heaviest block on bottom and progressively lighter ones on top. All five blocks are used to test a 2-ton hoist. Combinations of blocks are used to test units of intermediate ratings.

The top block (330 lbs) has two ½-in. by 2-in. inverted-U flat-iron straps which extend down two sides of the stack of weights. Holes in these straps match holes drilled in edges of blocks which accommodate bolts to "hitch up" the requisite number of blocks for a specific load test. Thus, the insertion or removal of four bolts will add or subtract any specific block in the weight assembly. Sturdy guide brackets, centered and bolted to opposite edges of each block, ride the inner flanges of the I-beam track to assure operating stability and prevent side-sway of the grouped load weights.

A sturdy metal eye-bolt on a heavy base plate bolted to the top block provides the lifting eye for this tiered arrangement of test weights. Block dimensions and weights were tailored to fit the specific space and work requirements of the Whitney shop. Prime goal was to have a test device flexible enough to handle the range of hoists coming in for repair. Now, Whitney management knows, and its customers are assured, that a hoist passing this final check-out test should operate satisfactorily within its prescribed design limits.



WHY

settle for an ordinary voltage tester?

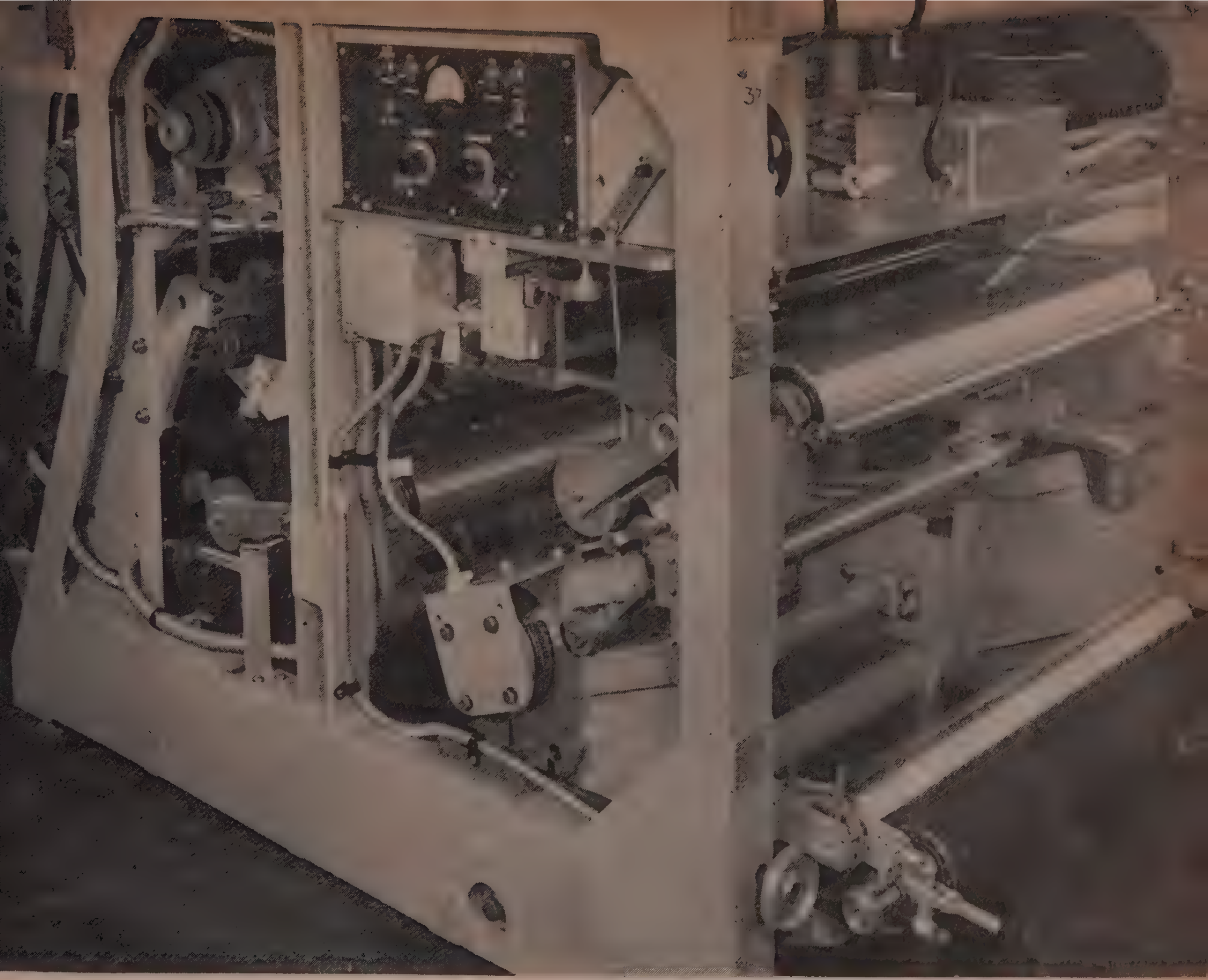
The AMPROBE Jr. gives you so much more...not just a run-of-the-mill voltage tester but a precision-made instrument that measures voltage *and* current instantly and accurately without shutting down equipment. All this with one rugged and inexpensive pocket-size tool! And now...FOR THE FIRST TIME...at the request of utilities, industrial plants and other large-scale users of AMPROBES, the AMPROBE Jr. has gone SAFETY YELLOW to conform with standard safety practices.

PICK THE AMPROBE *YOU* NEED! There's an Amprobe for every job, every budget: from 10 amps and 250 volts to 1200 amps and 600 volts AC; from $19.85 to $67.50. And with the Amprobe RS-3, you get a volt-amp-*ohmmeter* all in one pocket-sized, snap-around precision instrument. Every Amprobe comes with test leads; most with top grain cowhide leather case at no extra cost. See the complete Amprobe line at your jobber's today.

Ask yourself these questions	The AMPROBE Junior	ordinary voltage tester
Does it measure current as well as voltage?	YES	NO
Does it give you full visibility on a graduated reading scale?	YES	NO
Does it fit conveniently in your pocket?	YES	YES
Does it measure within ±3% accuracy?	YES	NO
Does it come in a full line of models to meet different problems?	YES	NO
Does it protect you against shorts and shocks?	YES	YES
Does it balance loads, locate grounds, determine motor overloads, check rating of circuit breakers?	YES	NO

Amprobe Jr.®
snap-around volt-amp tester
$19⁸⁵

PYRAMID INSTRUMENT CORP., Lynbrook, New York



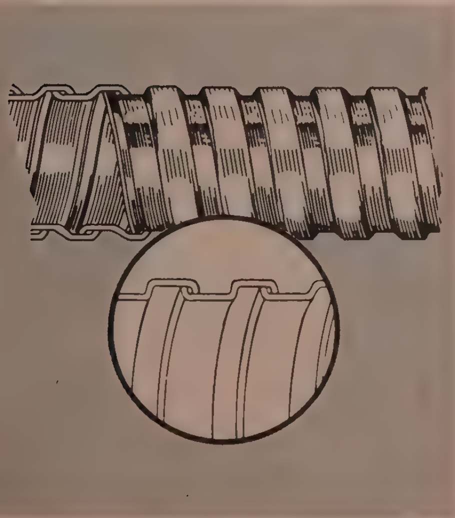
XeroX* Copyflo* Continuous Printer with panels removed shows compact wiring installation possible with Anaconda Type DSL conduit.

TURN TIGHT CORNERS EASILY WITH ANACONDA TYPE DSL EXTRA FLEXIBLE WIRING CONDUIT

The compactness of modern design calls for Anaconda Type DSL extra flexible wiring conduit—made especially for jobs where small bends are required. For example, look at the interior of the XeroX Copyflo continuous printer shown above—a great deal of wiring, enclosed in DSL, was snaked around in relatively tight quarters.

Anaconda Type DSL is high-quality conduit made of galvanized steel—without packing, for more flexibility. It comes in a full range of sizes—3/16″ I.D. through 3/4″ I.D.—in convenient standard length coils. For complete information and specifications contact your electrical wholesale supply house or write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. 60136

*Registered trademarks of Haloid Xerox Inc., Rochester, N. Y.

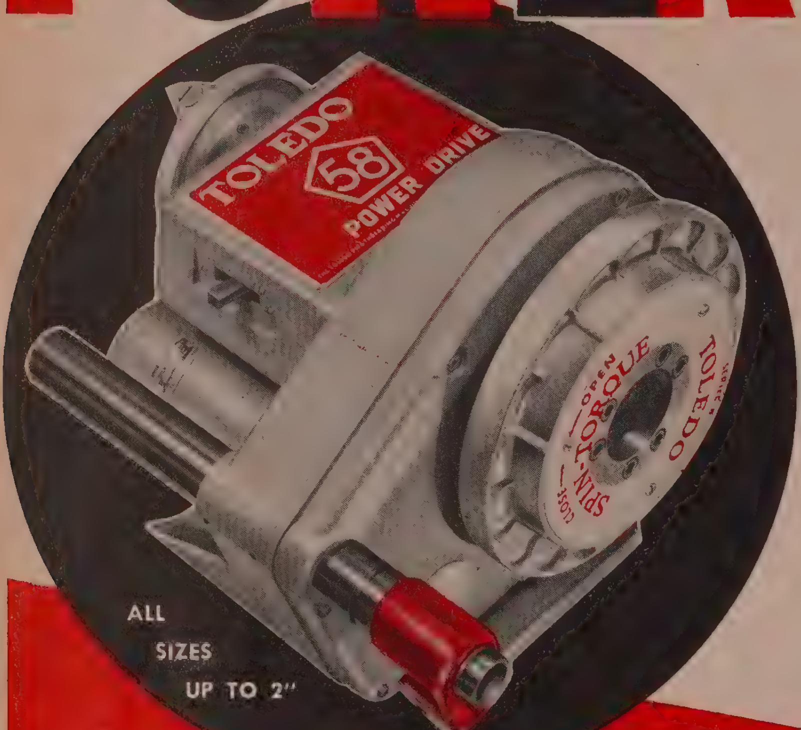


Cross section of Anaconda Type DSL conduit. Made from galvanized steel, without packing; extra flexible construction.

TYPE DSL

extra flexible wiring conduit

an **ANACONDA**® *product*



POWER

ALL
SIZES
UP TO 2″

WHEN YOU NEED IT--
WHERE YOU NEED IT

Perhaps it's for threading, cutting or pulling wire through conduit. Or maybe you need power for turning, hoisting or winching. No matter what the job, TOLEDO has the power drive for you. Choose the rugged new 58—converts hand tools to power in seconds—or the handy, lightweight 68. Both are precision built for longer service life

Only 73 lbs., the 58 has TOLEDO's new Spin Torque Chuck, factory-lubricated gear train, heavy-duty motor, and many more outstanding features. It makes threading and cutting by hand old-fashioned.

The versatile 68 weighs only 33 lbs., but does the work of power drives many times its size. When fitted with a square socket adaptor, it has literally dozens of uses. If you need portable turning power, you need the 68.

Write today for complete information, or see your nearby TOLEDO distributor.

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favorite distributor

TOLEDO®

BUILDERS OF THE WORLD'S FINEST PIPE TOOLS

THE TOLEDO PIPE THREADING MACHINE COMPANY   TOLEDO 4, OHIO, U.S.A.

Lifts Cut Handling Time

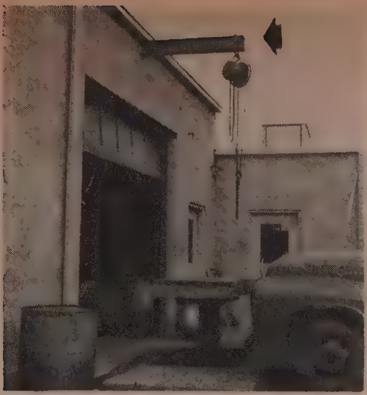
Lifts, whether they be hydraulic, electric or mechanically operated, are a great time-saving feature of Electric Maintenance and Repair Company's motor shop operation in Jackson, Mich.

Three types of lifts (not including an assortment of cranes and hoists used directly in connection with their motor repair work) expedite the loading, unloading and storage of motors and equipment. Not only do the lifts improve shop housekeeping; they also eliminate many of the hazards inherent in the manual method of handling heavy equipment.

For example, when it is necessary to store a motor or any other piece of equipment in the shop's second floor storeroom, a platform hoist with a 4-ft square base is used. The electrically driven, cable-operated hoist rides a set of vertical rails installed between the two floors. Pushbuttons and limit switches provide controls for the unit that allow operator to lower or raise load with a single finger. A recessed ground floor pit in the unit's well allows the platform to be lowered even with the floor, thereby permitting loaded hand trucks or carts to be easily wheeled onto the platform to be hauled upstairs without removing their contents. Unit may also be stopped at any height to permit easy transfer of a load from a fork lift truck that is used for in-shop movement of heavy equipment.

To load outgoing, or unload in-

PLATFORM HOIST, 4-ft square rides between ground floor and second floor of motor shop on vertical rails. The electrically driven, cable operated hoist is pushbutton-controlled, allowing operator to raise or lower load with a single finger. A. "Gus" Bahlau shown operating unit is one of the owners of the Electric Maintenance and Repair Company in Jackson, Mich.



LIFTS solve all problems of loading and unloading equipment at the shop and at customer's door. For extra heavy equipment the hydraulic cylinder lift is used. Mechanically operated chain hoist attached to I-beam lifts lighter equipment.

coming equipment a used automobile hydraulic cylinder lift is employed. The 4- by 3-ft table of the unit consists of 8 in. of reinforced concrete banded with steel to protect its outer top edges. The unit (when all the way down) fits perfectly into an 8-in. deep opening recessed in a concrete apron that is installed in front of the shop's rear overhead door. A 2-hp motor operates the lift's compressor. Since the lift can be raised or lowered to meet the platform of any size truck it is invaluable for loading and unloading heavy equipment. And, once an item is unloaded from a truck onto the unit's table the shop's fork lift truck can be employed to carry the item to any position in the shop where it can be handled by a series of overhead cranes and hoists. Or, if desired, the item can be delivered via the fork lift truck to the platform hoist and hauled to the second floor to be stored. The same procedures, only in reverse, are used to load heavy outgoing equipment.

STACKS OF DRAWERS hold groups of spare parts for variety of fractional horsepower motors repaired at Whitney Electric Co., Toledo, Ohio. Extent of stock is indicated by one segment of parts room where tiered shelves house 180 metal trays (16 in. by 14½ in. by 4 in.) catalogued according to make and item.

. . . by more contractors than any other portable cord

The cord that clicks with contractors is ROYAL . . . and the reasons are many. Made to high standards of quality, and controlled every step of the way under one roof, Royal cords offer the quality characteristics that you look for most in your work — flexibility, durability and dependability.

Royal offers the most complete range of types and sizes, too, through your electrical wholesaler; one recognized and respected name on all your flexible cord — Rubber, Neoprene and Plastic Jacketed Portable Cords, Thermostat Cable, Lamp and Fixture Wires, Machine Tool Wires, and heavy duty "POWR-KORD" extensions.

Next time you order cords, specify ROYAL.

Royal Electric Corporation
Pawtucket, Rhode Island

ROYAL ELECTRIC
...an associate of IT&T

THE MARK OF SORGEL

DRY-TYPE TRANSFORMERS • SPECIAL TRANSFORMERS
SORGEL ELECTRIC CO.
QUIET QUALITY
MILWAUKEE, WISCONSIN
INDOOR UNIT SUBSTATIONS • D. C. SATURABLE REACTORS

your guarantee of the preferred
DRY-TYPE TRANSFORMERS

Look for this gold seal on dry-type transformers. It is the true mark of creative engineering and manufacturing craftsmanship. It represents the choice of a Consulting Engineer who specified the best; a Plant Engineer who wanted to be assured of dependability, rugged construction, high efficiency, a full-rated load operating continuously at a safe temperature; a Wholesaler who recommended for performance first; a Contractor who insisted on guaranteed delivery, installation ease, versatility of application, plus a competitive price; and a satisfied customer who is enjoying the great operating economies found only in Sorgel's expertly designed, carefully constructed, sound-rated, dry-type transformers. Complete engineering data and design services are available from your experienced, local Sorgel Sales Engineer, or from Sorgel's sales headquarters in Milwaukee.

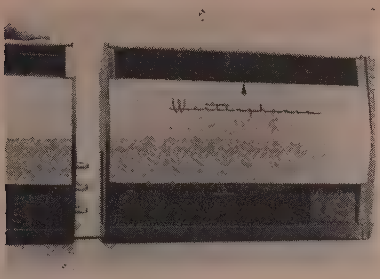
SORGEL
SOUND-RATED DRY-TYPE
TRANSFORMERS

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts,
Including Special Transformers and Saturable Reactors

SORGEL ELECTRIC COMPANY

839 W. NATIONAL AVENUE • MILWAUKEE 4, WISCONSIN

Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.



Electric Heating (1)

A new line of baseboard electric heating equipment features the use of modular plug-in sections. Electrical connections are required at one point only—in the control section. Additional sections are installed by "plugging-in" to control section through a concealed three-pronged connection. Double-male grounded plug provides continuous flow of power to each section. One standard 2-ft length is available. In addition, the line includes a new "universal" corner section which can be used to provide continuous right angle connection for either an "inside" or "outside" corner. Control section is 9½ in. long; electrical connections can be made either from bottom (floor) or back (wall). It includes a combination double pole switch and bellows. Each section is equipped with new "thermal safety protection." They are adaptable to both existing and new home construction. End of each section is one piece, made entirely of plastic, designed to accommodate the connecting terminals. Each section has an output of 500 watts and is available with a choice of 120, 208, 240 or 277 volts.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Limit Switch (2)

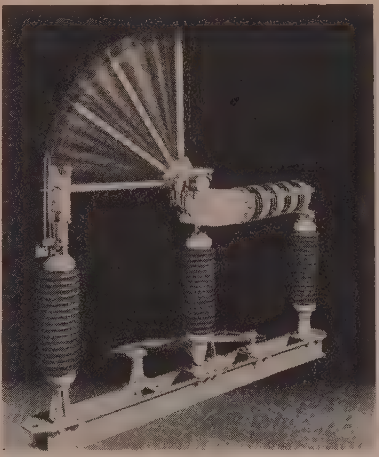
A new plug-in limit switch has double duty capability. Switch contains two 2-circuit double-break switches which can control four isolated circuits. Roller lever actuator, when moved to left, operates one of these basic switches and, when moved to right, operates the other. Operating characteristics are the same in either direction. Basic switches and terminals are mounted in aluminum housings. When properly connected to a sealed conduit, the complete assembly is oiltight.

Micro Switch, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Fluorescent Fixture (3)

Type HLG is a weatherproof fluorescent fixture especially designed for outdoor and indoor use. Unit has a shatterproof plastic lens. Housing is an extruded aluminum channel with cast aluminum end caps. Door opens by turning three catches. All alloys are corrosion-resistant and all points are gasketed. When mounted on a ceiling in continuous rows the wide light distribution provides some light on the ceiling.

Crouse-Hinds Company, Syracuse 1, *N. Y.*



Circuit Switcher (4)

A new development for high-voltage switching named Circuit-Switcher has been introduced for 34.5 through 138 kv. Circuit-Switcher, resembling a load interrupter switch in appearance but working more like a circuit breaker, is a generic name for a new family of switchgear for handling a number of circuit-interrupting duties. It is presently designed for all forms of load switching. Heart of device is an interrupting unit capable of carrying current continuously and withstanding short-time surges, combined with a "brain" mechanism that gives built-in operating sequence control. To combine both continuous-current-carrying capability and high-speed circuit interruption in the interrupting unit, two movable contact rods working in parallel are used. One rod is massive to carry load. The other rod is light for high-speed travel.

S&C Electric Company, 4435 *N. Ravenswood Ave., Chicago, Ill.*

Motor Control Centers (5)

Motor control centers with bus capacity from 200 to 2000 amps for voltages from 110 to 600 are now available either as fusible or circuit breaker combination units. Centers consist of two or more starters fed from a common bus and are often attached to transformers or switchgear to form a unit substation. All control compartments of like size are interchangeable anywhere in the control panel. New units have two doors for dual-mounted breakers which permits one breaker to be serviced without interruption to the other.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*

Electric Baseboard Unit (6)

A new electric baseboard unit operates on 115-, 208- or 230-volt circuits and is equipped with individual thermostatic controls or may be adapted to room control. Unit will deliver a Btu output equivalent to 200F water. The finned element requires 200 watts per lineal foot. Connection boxes are available at either end of unit. Continuous wall-to-wall installations are simplified with a complete line of snap-on accessories, enclosures and trim pieces. It is approved by UL and available in 4-, 6- and 8-ft lengths. Literature is available.

Radiant Baseboard Panels, Inc., Newington, Conn.

"Since 1857"

It's a pleasure to use good tools—pliers that grip tight . . . that cut through tough wire easily . . . that reach confined spaces.

Linemen and electricians know that they can rely on their Kleins—side cutters, long nose, oblique cutters—famous for quality for a century.

There is a Klein Plier exactly suited to every electrical need—carried in stock by better electrical suppliers everywhere.

FREE POCKET
TOOL GUIDE

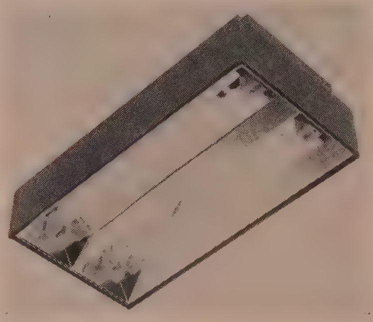
A free copy of the new Klein Pocket Tool Guide will be sent on request without obligation.

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Housings (7)

Cast from aluminum alloy, these explosion-proof housings were tested at pressures up to 275,000 lbs force exerted against the cover for UL listing in Class I, Group D, and Class II, Groups E, F, and G, hazardous locations. Housings are non-magnetic, non-sparking, and are light in weight. Flanged surfaces are ground flat. Recommended applications include housings for equipment starters, relays, splices and permanent terminal panels. They are particularly suitable for use with control panels. Housings are furnished "blank" from stock in 33 sizes up to 24 by 24 by 8 in. Bulletin No. 160 is available.

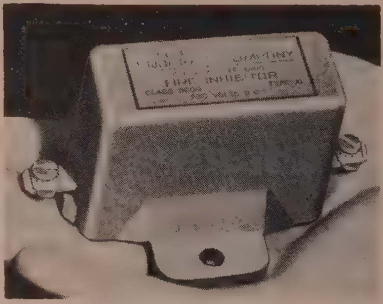
Adalet Manufacturing Co., 14300 *Lorain Ave., Cleveland* 11, *Ohio*



Heating Unit (8)

New infrared heating units especially designed to make reflected radiant heating practical for almost all indoor and outdoor, open-area applications. The new Luminator infrared units are designed with reflectors for use with G-E T-3 tubular quartz infrared lamps having filament temperatures in excess of 4,000°F. Lamps convert approximately 85% of their energy into radiant heat similar to that of the sun. Luminator units then project this heat in the same manner that light is projected and instantly warm people and surfaces directly. Units are designed so that the projected heat can be directed to specific areas. Units are available as one-lamp fixtures ranging from 500 to 5,000 watts; 2-lamp fixtures ranging from 1,000 to 10,000 watts; and 3-lamp ranging from 1,500 to 15,000 watts. Length of fixtures range from 10½ to 55½ in.

Luminator, Inc., 120 *N. Peoria St., Chicago* 7, *Ill.*



Arc Inhibitor (9)

A new arc inhibitor is for use with dc crane and mill controllers operated by master switches or pendent pushbutton stations. Inhibitor both suppresses arcs and absorbs voltage surges to keep voltage rise within safe limits. They are recommended for 115- and 235-volt dc inductive circuits and are connected in parallel across the coil terminals of magnetic contactors. Vital components are embedded in an epoxy resin compound for protection against dust and moisture. Bulletin 9600 is available.

Square D Company, EC&M Division, 4500 *Lee Road, Cleveland* 28, *Ohio*

Load Break Device (10)

A new gas load break device for open dropout fuse cutouts designed to meet the utility's need for safety and reliability. A small, replaceable gas-filled monel cylinder positioned in fuseholder's upper contact makes each open type cutout a load break switch. As cutout is opened, cylinder tip is last part of fuseholder to leave upper contact. Load current arc, drawn between cylinder tip and upper contact, burns cylinder tip and releases a jet of compressed insulating gas which extinguishes the arc. Load break operation and cutout fault clearing action are completely independent of one another. It is available in both 7.8- and 15-kv heavy duty and extra heavy duty fuseholders rated 100 amps and in disconnect blades rated 200 amps.

General Electric Co., Schenectady 5, *N. Y.*

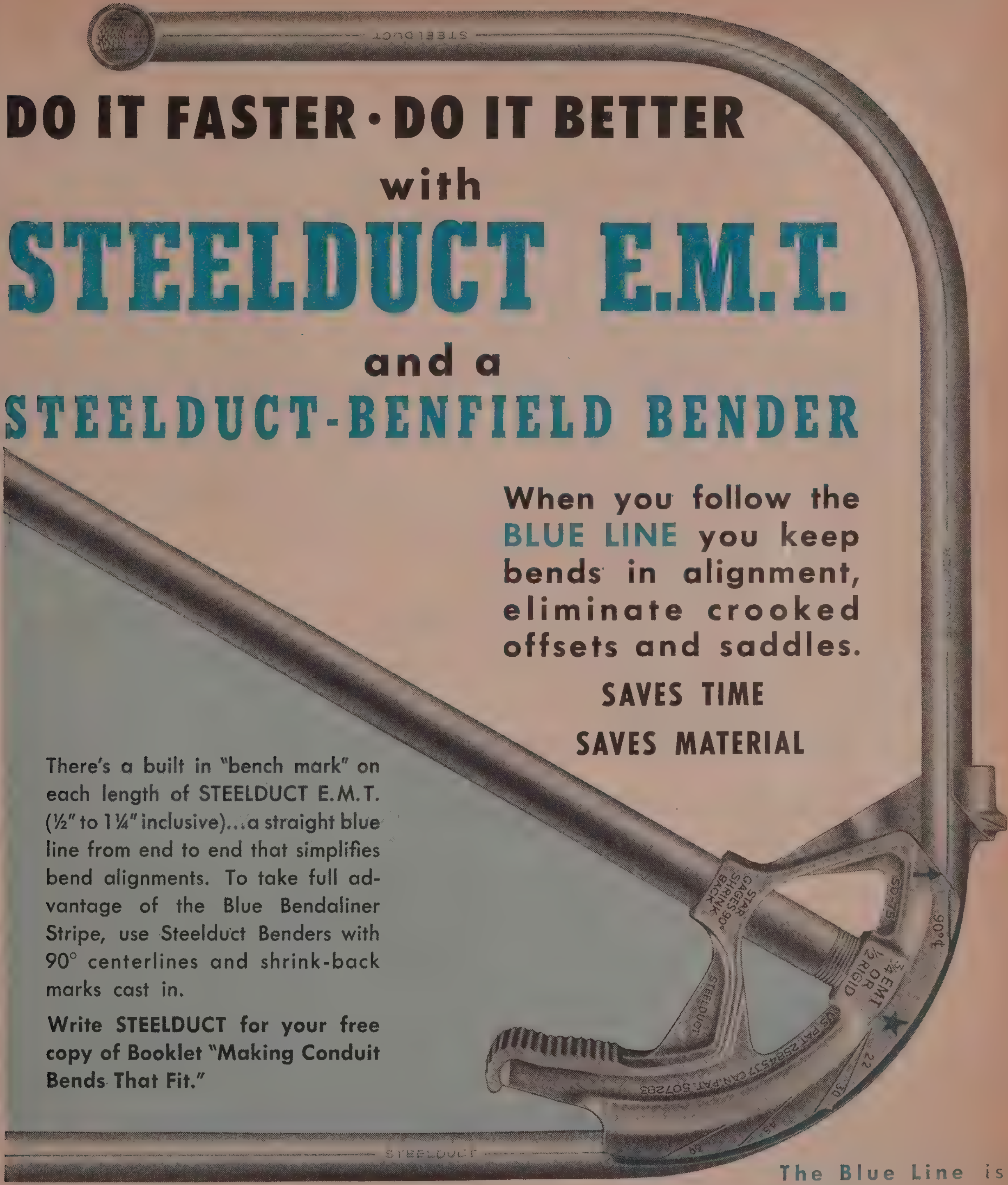
DO IT FASTER · DO IT BETTER

with

STEELDUCT E.M.T.

and a

STEELDUCT-BENFIELD BENDER



When you follow the BLUE LINE you keep bends in alignment, eliminate crooked offsets and saddles.

SAVES TIME

SAVES MATERIAL

There's a built in "bench mark" on each length of STEELDUCT E.M.T. (½" to 1¼" inclusive)...a straight blue line from end to end that simplifies bend alignments. To take full advantage of the Blue Bendaliner Stripe, use Steelduct Benders with 90° centerlines and shrink-back marks cast in.

Write STEELDUCT for your free copy of Booklet "Making Conduit Bends That Fit."

The Blue Line is the Mark of Quality

Steelduct Products are UL approved and meet Federal Specifications WW-C-571a, WW-C-581c, WW-T-806b.

THE STEELDUCT COMPANY

REPUBLIC STEEL BUILDING
YOUNGSTOWN 1, OHIO

Have You Tried a
RIDGID®
Hex Wrench
Yet?

the
Perfect Mate
for your
RIDGID
Pipe Wrench!

Six Sizes with Maximum Jaw Openings of 1 1/16″, 1½″, 1¾″, 2½″, 3½″ and 4⅞″ across flats.

Finest of All Adjustable Smooth-Jaw Wrenches

MORE GRIPPING POWER... for all nuts. Puts a wrap-around grip on hexes that just won't slip. Because you're pulling with at least three flat sides at once, you'll never round off shoulders. Works on square nuts, unions and flatheads, too. Smooth jaws won't even mar polished or plated surfaces.

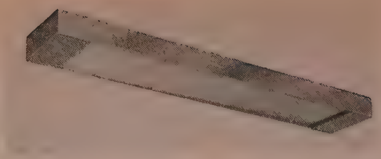
RUGGED CONSTRUCTION... built good and solid. Thin but extra-strong jaws slip into tight places. The first time you use a hex wrench you'll know that here's a wrench you'll use for a long, long time. It's every bit as rugged as your familiar RIDGID Pipe Wrench.

No. E-110 Offset Hex Wrench
Big Jaw, Short Handle for Sink and Tub Drain Nuts—Maximum Jaw Opening—2⅝″ across flats

No. E-11 End Hex Wrench
Offset Jaw for Easy Work in Tight Places
Maximum Jaw Opening—1½″ across flats.

From experience you know it's easier to work with the best of tools. Order your RIDGID Hex Wrenches from your Supply House today!

RIDGID®
The Ridge Tool Company, Elyria, Ohio, U.S.A.



Ceiling Heater (11)

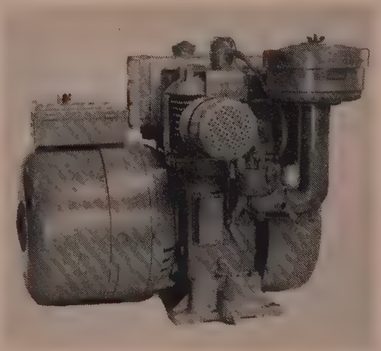
New thin ceiling heater, called Zonemaster C-209, is for farm and commercial use. It is 2 in. deep and can be surface mounted on noncombustible ceilings or suspended from standard ceilings. It utilizes the flat quartz element. From 8 to 10 ft, the C-209 will heat an area of approximately 125 sq ft. It is 6 in. wide, 36 in. long, and can be installed between lighting fixtures for decorator effects. Ratings are C-209, 2000 watts; C-209-3, 3000 watts; 240 volts with 208 volts or 440 volts available.

Ampere Industries, 60 *Boston St., Newark* 3, *N. J.*

Instrument (12)

A new line of sealed hour meters, which tell at a glance in hours and minutes the cumulative operating time, up to 100,000 hours, of any machine, tool or equipment run with 120 to 480 volts ac. Available in 2- and 3½-in. diameters, the ac meters are in black bakelite cases with 2.94-in. overall depth.

Hobbs Division, Stewart-Warner Corp., Springfield, Ill.



Electric Plant (13)

A new electric generating plant will deliver its full capacity at either 110- or 220-volts ac. Two separate receptacles are provided. Plant is powered with a Briggs & Stratton air-cooled engine and has a capacity of 2500 watts. This dual voltage plant is for use in the construction field and for emergency standby service in homes and business. Literature is available.

Universal Motor Company, 438 *Universal Drive, Oshkosh, Wis.*

Note how ordinary EMT split early in pressure test while induction welded CIRTUBE EMT (shown here unplated) held fast, surpassing UL requirements.

BETTER WELDING

on new CIRTUBE EMT means easier, split-free bending

THERE are many reasons why new CIRTUBE EMT will help you get faster, cleaner wiring jobs. Most of them are listed here.

One *big reason,* however, is *continuous induction welding*—by far the best technique available for making bead-free, split-free welds on high quality EMT.

It is virtually impossible to split an induction-welded EMT no matter how severe the bends. And the perfectly clean weld means uniform roundness—easier, neater bending without the slightest kink or flattening. Your men get it right the first time around.

Try induction-welded new CIRTUBE EMT soon as you can. Your wholesaler has it now—bundled with distinctive orange colored tape to identify the EMT manufactured to Circle's quality standards.

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** in all principal cities
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

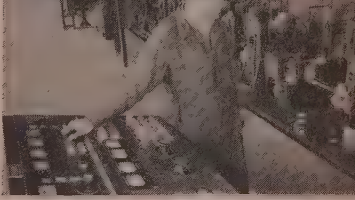
CIRTUBE EMT *Ask for it!*

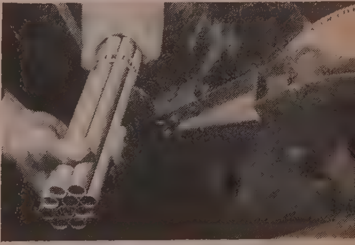
Proper steel plus! The best col rolled steel plus the right handling giv CIRTUBE EMT its natural bendability.

Easy fishing! A baked-on protectiv coating gives CIRTUBE EMT a built in lubr cation for easier wire pulling.

Lifetime exterior finish! Har galvanized finish for durability; polishe satin lustre for lasting good looks.

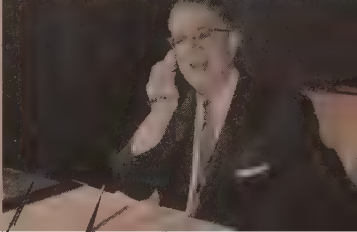
Automated quality control! Automatic controls assure complete an continuing uniform quality of product.





Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EM securely for easy handling on and off the job

Fast, friendly service! Well-know Circle service through a nation-wide networ of well stocked nearby warehouses.



LEVITON *specification grade* Switches and Receptacles

Compare Leviton wiring devices under any conditions . . . Leviton gives you the utmost in performance at minimum cost . . . with absolutely no compromise in quality.

SPECIFICATION GRADE INCLUDES

The Complete "5000" Line
Combination Line
Lev-O-lock Line
Quickwire Line
U-grounding Devices
Interchangeable Devices
Lev-O-let Line

CHECK THESE TYPICAL FEATURES

- Heavily sectioned molded phenolic bases.
- Full gauge straps, completely rust proofed and riveted to assemblies.
- Plaster ears — wide and break-off types.
- Terminal screws with large heads to accommodate No. 10 conductors and backed out for quick wiring.
- Individually packed with mounting screws attached to straps.
- All switch mechanisms utilize high grade bronze for wide, double wiping contacts.
- Assemblies riveted for permanence.
- All power outlets have double-wiping phosphor bronze contacts.
- Meet U.L., C.S.A. and Federal Specifications.

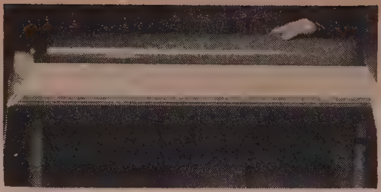
LEVITON

Samples on Request

LEVITON MANUFACTURING COMPANY
BROOKLYN 22, N. Y.

Chicago • Los Angeles • Leviton (Canada) Limited, Montreal
For building wire and cable contact our subsidiary: AMERICAN INSULATED WIRE CORP.

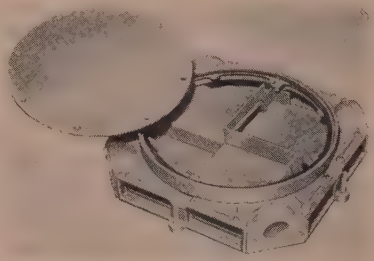
SEE US AT THE 10TH BIENNIAL ELECTRICAL INDUSTRIES SHOW, LOS ANGELES
SHRINE EXHIBITION HALL, MARCH 23-26, BOOTH 311



Lighting System (14)

Compact fluorescent lighting system, called Controlled Powerbeam System, throws a narrow band of light for a considerable distance with a minimum amount of glare. Unit is for use in low-mounted highway lighting, bridge and tunnel light, expressway turn-offs, service stations, building facade floodlighting, and edge lighting for signs. It can also be used as a linear fluorescent automobile headlight. Lamp in the powerbeam unit is a VHO (very high output) with a special reflective interior coating. Light emits from tube through an optically precise window or "aperture." Light is reflected to desired area by the fixture. Units are 4 ft long. Weatherproof ballasts are supplied for outdoor applications.

Sylvania Lighting Products, 60 *Boston Street, Salem, Mass.*



Junction Boxes (15)

New junction boxes for underfloor electrical distribution systems in slabs of 2½ in. and deeper. No. 222-2½-1S accommodates two Walker No. 2 ducts, 1¼ by 3⅛ in., per side and features removable interior partitioning which eliminates trouble for the contractor should direction of box partition require changing after concrete is poured. Box 3222-2½-1SC accommodates three No. 2 ducts per side. Both boxes accommodate 1¼-in. conduit in four corners and are furnished with rings of 1-in. minimum height. Boxes feature large handhold openings, 1-in. spacing between ducts and 4-screw leveling—ring and top assembly can be raised to final screed line before or after concrete has set and without removing cover plate.

Walker Brothers, Conshohocken, Pa.

Heating System (16)

A new all electric duct heating system for use in residences in connection with a central air conditioning unit. System consists of electric duct heating units installed directly in the air distribution system using the air moving equipment of a self-contained or remote air conditioner for the distribution of the heated air. Use of individual room duct heaters located immediately before the outlet diffuser in the room, and controlled in the room by a separate thermostat, allows for complete flexibility in meeting individual heating requirements and minimizes operating cost. An interlocking relay is included in the assembly to prevent operation of the tempering heaters while the cooling unit is in operation.

York Division of Borg-Warner Corporation, York, Pa.

Slotted Angle Framing (17)

New line of slotted angle steel framing for the suspension and structural support of electrical installations, called the Right Angle Method. The line is produced in three sizes—Type RA 150, size 1⅜ by 1⅜ in. of .067-in. thickness; Type RA 225, size 2⅜ by 1⅝ in. of .080 thickness; and Type RA 300, size 3⅛ by 1⅝ in. of .104 thickness. Each type has measure and cut marks spaced at ¾-in. intervals, with a special mark at 3-in. intervals. The RA 150 will be packaged in ten 6-ft lengths, with an accompanying quantity of 60 bolts and nuts, size 5/16 in. Larger sized RA 225 and 300 will be packaged in five lengths of either 10 or 12 ft, with 36 bolts and nuts of ⅜ in. size. The Right Angle method is designed for interchangeable application in all sizes within the same structure and with other makes of slotted angles. A portable cutting instrument with centering pin for exact cutting mark alignment is available and adapted to all three sizes of slotted angles.

Steel City Electric Co., Pittsburgh 33, Pa.

SELF-DRILLING MASONRY ANCHOR
RAWL
SABER-TOOTH®
DRILL-N-ANCHOR
DURATHERM
HEAT TREATED TO...

DRILL FAST!

Install a Saber-Tooth anchor in only 45 seconds! Core-action drilling cuts only the masonry around the hole's perimeter . . . the core crumbles and ejects out the chuck hole. DURATHERM-hardened teeth drill the toughest masonry . . . even granite! This anchor that drills its own hole saves you buying or sharpening drills, eliminates matching drill and anchor sizes, measuring for proper hole depth.

HOLD TIGHT!

A ⅞" Saber-Tooth holds nine tons! DURATHERM-treated teeth undercut the drilled hole and expand deep in the masonry, back-tapered ridges add resistance to pullout, for highest holding power . . . the concrete or the bolt will usually break before the anchor comes out! UL, FM approved, in full range of sizes and styles, including 3/16" snap-off flush-type, especially for electrical work.

Get all the facts on Saber-Tooth and other masonry anchors.

For a FREE copy of the new "Masonry Anchoring Handbook," with helpful hints and complete specifications on all types of masonry anchors and drills, ask your supplier or local Rawlplug branch, or send this coupon to:

R-11

The RAWLPLUG Company, Inc.
212 Petersville Road, New Rochelle, N. Y.
Please mail my FREE copy of the "Masonry Anchoring Handbook" to

Name
Title
Company
Address

HOW GOOD IS...
AN IMITATION Amp-trap®?

for
600 Volts
or less

Amp-trap®
VS IMITATIONS

Amp-traps are *our* products. We originated and developed them. We alone manufacture them. They are so good that others are now imitating them. This is flattering because it indicates Amp-trap is superior. But, don't be confused by imitations.

Amp-trap®
VS SUBSTITUTES

"Just like Amp-trap." "As good as Amp-trap." "Works like Amp-trap." "Better than Amp-trap." These are the deceptive phrases that imitators must use. Without them they can neither explain nor sell their substitutes.

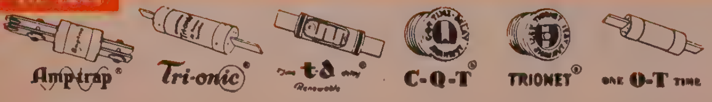
NOTHING TAKES THE PLACE OF
Amp-trap®

Whenever you *need* Amp-trap, you *want* Amp-trap — not an imitation or a substitute. Amp-trap is a very special current limiting device with high interrupting capacity. Regardless of claims, imitations aren't enough. More than 27 patents prove it. *Nothing takes the place of Amp-trap!* For your own protection specify Amp-trap. Then — make sure you get it.

Amp-trap® – *Awake At The Switch*

REGISTERED UNITED STATES PATENT OFFICE
S

THE CHASE-SHAWMUT CO.
374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS
Subsidiary of I-T-E CIRCUIT BREAKER CO.,



Fluorescent Ballast (18)

A solid fill ballast with case, core and coil permanently bonded into a single unit. It contains a stable thermo-setting material that will not react or combine chemically with any other material in the ballast. It cannot soften or liquefy. New material has high dielectric strength. The "locked-in" design of Dri-Lok reduces ballast hum. Heat conductivity of its thermo-setting material, coupled with the voidless filling and bonding of ballast, result in cooler operation.

Jefferson Electric Co., Bellwood, Ill.

Drilling Machine (19)

A new method of dry-drilling reinforced concrete, known as "Method A," is for use in areas where dust and noise would be prohibitive, such as in hospitals, hotels, offices, institutions, food-processing and industrial plants. It incorporates Cyclo-core bits, dust exhaust swivel, power unit, and dust collector. The Cyclo-core drilling machine used in "Method A" is portable, and only one operator is needed to operate it.

New England Carbide Tool Co., Inc., 55 *Commercial St., Medford* 55, *Mass.*

Bar Hangers (20)

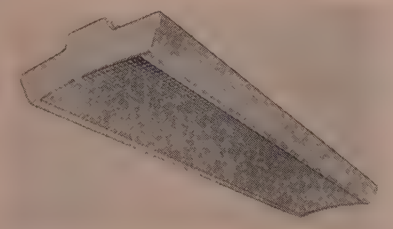
"No-Notch" bar hangers speed drywall installations of recessed boxes and hi-hats. They are adjustable and attach to the sides of joists. Hangers are tipped with slotted, "L"-shaped ends that are nailed to the sides of joists. They are adjustable to any joist spacing up to 24 in. by means of a slide-clasp, allowing easy lengthening or shortening. Hangers can be positioned high or low on joist sides, allowing for any proposed thickness of drywall, including any acoustical material that may be used after drywall installation. The pre-wired and unwired Lumidome recessed housings and hi-hats are equipped with special flanges. Literature is available.

Markstone Mfg. Co., 1531 *N. Kingsbury St., Chicago* 22, *Ill.*

Pushbutton **(21)**

A new illuminated pushbutton saves mounting space by combining in a single device both a pushbutton and pilot light. It features pressure connectors to eliminate internal wiring. It has the same single-hole mounting as other oil-tight units. A full range of voltage ratings and a choice of six color caps provide added versatility. Contacts are rated for heavy-duty service. Bulletin 9001-T is available.

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.



Fluorescent Unit **(22)**

A new all plastic fluorescent luminaire, called the Gateway. Choice of concave Gratelite louver-diffuser—the ⅜-in. open cubicle plastic, or concave Prismoid Gratelite, the reversible prismatic louver-lens. Gateway features tubular designed plastic side wings, capped to minimize maintenance. Continuous one-piece 8- and 4-ft side wings. Concave Gratelite bottoms hinge separately. Units are for pendent mounting, or adaptable for close-ceiling mounting with top plates, in schools, stores and offices. Available in 2-, 3- or 4-light units. Brochure is available.

Edwin F. Guth Co., St. Louis 3, Mo.

Power Pedestals **(23)**

Power pedestals equipped with eyebolt terminal strips are designed primarily for use with Transclosures and pad-mount transformers. They facilitate above-ground connections of underground services to secondary mains. Pedestals will accommodate 18 conductors, six 4/0 mains and 12 2/0 services. Provisions for padlocking makes these pedestals tamperproof. All live components are insulated. Tin-plated bronze eyebolt terminals accept conductors from No. 6 through 4/0 stranded. 4-in. fibre conduit risers can be accommodated for protecting conductors below ground level.

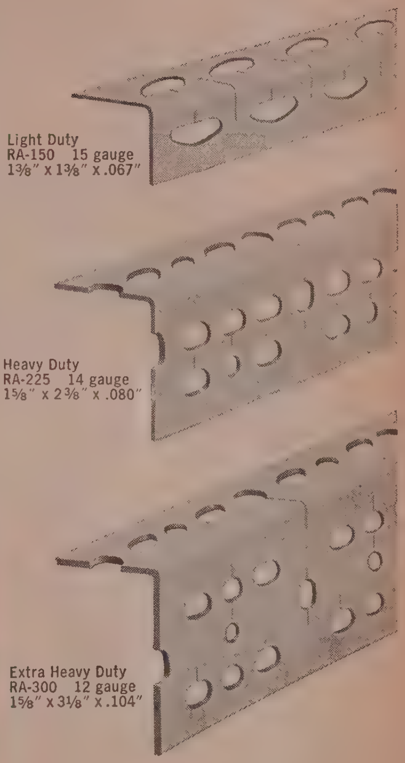
Line Material Industries, McGraw-Edison Company, Milwaukee 1, Wis.

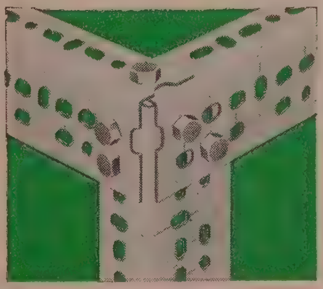
NEW! STEEL CITY SLOTTED ANGLE in 3 sizes

A Size, Weight and Strength for EVERY Job!

Steel City's RIGHT ANGLE* is fabricated in three sizes for maximum economy and utility . . . all sizes interchangeable within the same structure. The exclusive slot-and-hole pattern, recurring every three inches, provides the erector with a rigid method of securing joints. RIGHT ANGLE is structural quality steel, electro-galvanized *after* processing for complete protection.

*trade name





The RIGHT ANGLE method of forming a corner assures both ease of assembly and rigidity. A wrench is the only tool needed for erection.

"One-Man Carry" Packages

Catalog Number	Length	Package	Package Weight
RA-150	6′	10	35
RA-225-10	10′	5	48
RA-225-12	12′	5	56
RA-300-10	10′	5	72
RA-300-12	12′	5	84

Sixty 5/16" structural bolts and nuts included with RA-150. Thirty-six ⅜" bolts and nuts with each package of RA-225 and RA-300.

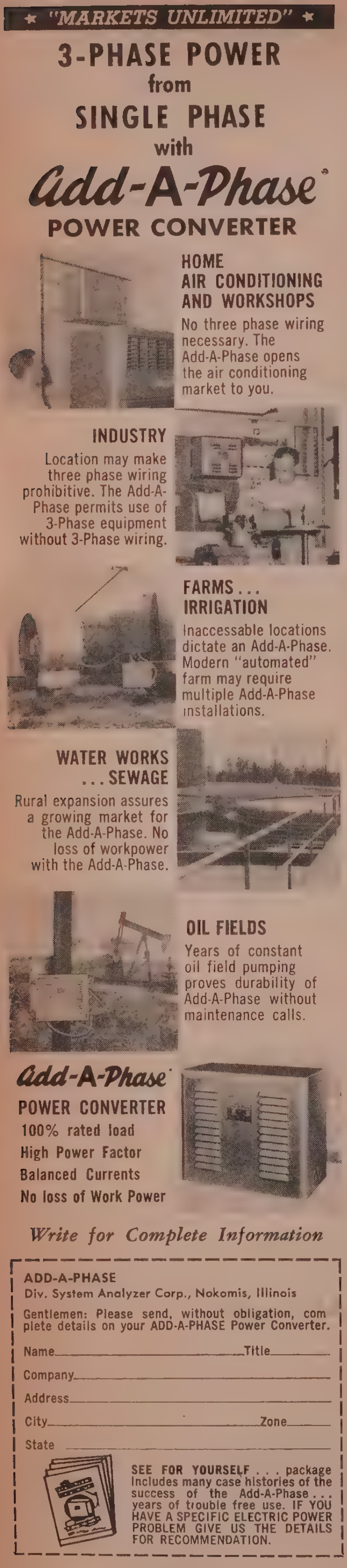
The specially designed portable Steel City Cutter cuts all three sizes of RIGHT ANGLE cleanly with one easy stroke.

Measure and cut marks every ¾"

Sold through wholesale distribution only!

Write for bulletin RA-1 or see our catalog in Sweet's files

STEEL CITY ELECTRIC COMPANY
A Subsidiary of American-Marietta Company
PITTSBURGH 33, PA.


★ "MARKETS UNLIMITED" ★

3-PHASE POWER
from
SINGLE PHASE
with
Add-A-Phase®
POWER CONVERTER

HOME
AIR CONDITIONING
AND WORKSHOPS
No three phase wiring necessary. The Add-A-Phase opens the air conditioning market to you.

INDUSTRY
Location may make three phase wiring prohibitive. The Add-A-Phase permits use of 3-Phase equipment without 3-Phase wiring.

FARMS . . .
IRRIGATION
Inaccessable locations dictate an Add-A-Phase. Modern "automated" farm may require multiple Add-A-Phase installations.

WATER WORKS
. . . SEWAGE
Rural expansion assures a growing market for the Add-A-Phase. No loss of workpower with the Add-A-Phase.

OIL FIELDS
Years of constant oil field pumping proves durability of Add-A-Phase without maintenance calls.

Add-A-Phase®
POWER CONVERTER
100% rated load
High Power Factor
Balanced Currents
No loss of Work Power

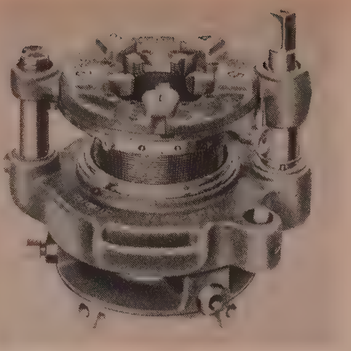
Write for Complete Information

ADD-A-PHASE
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name____________________Title__________
Company______________________________
Address______________________________
City________________________Zone________
State _______________________________

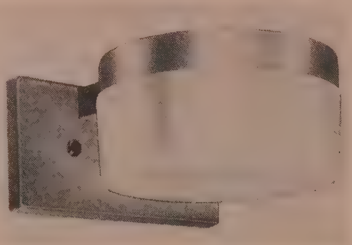
SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.



Threader (24)

New Ridgid No. 141 jam-proof geared threader threads 2½- to 4-in. pipe or conduit without changing dies. Threader adjusts for straight or tapered, over and under size threads. Cam-action workholder sets exactly to size by turning of the adjusting collar.

Ridge Tool Co., Elyria, Ohio.



Lighting Fixture (25)

A new aluminum wall bracket lighting fixture specially designed for use in halls, under overhangs, soffits, and porches. It is made with a hand blown, hinged Thermopal enclosing glass, 8 in. in diameter. Type R mounting strap locks aluminum base in desired position. Fixture comes in a variety of finishes. Overall dimensions are 9¾ by 4½ in.

Prescolite Manufacturing Corp., 2229 Fourth St., Berkeley, Calif.

Scanner (26)

With energy source and detector combined in a single unit 2¼ in. long by 1⅛ in. in diameter, the new Type SA-IR infrared photoelectric scanner, or proximity sensor, responds to metallic and non-metallic objects and provides means for handling a wide variety of counting and control operations. Unit will sense objects or control-areas at distances up to 2 in. Solid-state detector is sealed for protection against moisture, dust or corrosive atmosphere. The anodized aluminum housing in which both source and detector are contained, has provision for mounting in a single ¾ in. hole. A standard, 4-prong base permits plug-in connection to control circuit.

Farmer Electric Products Co., Inc., 2300 Washington St., Newton Lower Falls, Mass.

Control (27)

Type "PT" crane control features self-contained undervoltage and overload protection. It provides full magnetic control on any dc application up to 55 hp, 230 volts. Heavy duty components throughout make control suitable for mill accessory drives as well as light industrial cranes. Compact controllers are front-connected for mounting against walls or girders, fit in cabs, on crane walkways or wherever space is limited. "PT" control is also supplied without protection for use with separate protective panel. Available in NEMA Type 1 general purpose, Type 1 gasketed, or NEMA Type 3 enclosures.

Square D Company, EC&M Division, 4500 *Lee Road, Cleveland* 28, *Ohio*

Beam Clamp (28)

A new fastening device called the Junior beam clamp is for securing conduits, switch boxes, pipes, etc. onto "I" beams, ceiling channels, web joists or any type of building framework requiring light-weight, flush-mounted fastening. Clamp fastens in any position. Device is designed for use with ¾ in. wide and up channels, ¼ in. and/or "I" beam members. It can also be adapted for a variety of other applications, including the horizontal or vertical holding of electrical boxes needed to feed recessed fixtures; also for hanging a continuous row of lighting fixtures in a variety of styles.

The Paine Company, 38 *Westgate Rd., Addison, Ill.*

CHANNEL MASTER ALUMINUM EMT

COSTS LESS THAN STEEL!

Channel Master Aluminum EMT provides the advantages you want. It costs less to buy... looks better longer... speeds up the job!

For a price below that of steel, you can have Channel Master Aluminum EMT, the lightweight tubing that *stays* good looking ... mirror bright, mirror smooth... inside and out. Aluminum EMT won't ever show its age.

Packaged in standard 10-foot lengths, chamfered at both ends, it is also easier to cut, bend, and put together. The hard-drawn, seamless raceway facilitates fishing and wire pulling. Standard inside and outside diameters match all U.L. approved EMT fittings.

Channel Master Aluminum EMT can be purchased through your regular distributor. Ask him to show you how to make faster, better installations at lower cost.

CHANNEL MASTER CORP. ELLENVILLE, NEW YORK

HOW THE ALUMINUM IN K/W
INTERLOCKED ARMOR CABLE
SAVES YOU MONEY...SPEEDS YOUR JOB

K/W 3 Conductors Interlocked Armor Cable Spec. 808-S vs. 3 Copper Cdrs. in Steel Conduit
COST AND WEIGHT COMPARISON—1000 FT.

600V RHW 75°C RUBBER 3 Copper Cdrs. in Steel Conduit							600V ALUMINUM INTERLOCKED ARMOR Aluminum Conductors, 90°C, Butyl Insulation						SAVINGS WITH ALUMINUM				
		CONDUIT															
Wire Size	Amps.*	Trade Size In.	O.D. Inches	Area Sq. In.	Total Wt.—Lbs.	Total Cost—$	Wire Size	Amps.**	O.D. Inches	Area Sq. In.	Total Wt.—Lbs.	Total Cost—$	% Bonus Ampacity Alum. over Copper	SAVINGS (1) $	SAVINGS (1) %	Weight Savings Lbs.	Space Savings %
2	115	1¼	1.66	2.17	2,860	903.	1	120	1.44	1.63	850	713.	4.3	190.	27	2,010	25
1	130	1½	1.90	2.82	3,570	1,155.	1/0	135	1.53	1.84	960	806.	3.8	349.	43	2,610	35
1/0	150	2	2.38	4.44	4,660	1,457.	2/0	160	1.63	2.07	1,115	926.	6.7	531.	57	3,545	53
2/0	175	2	2.38	4.44	4,960	1,609.	3/0	180	1.74	2.38	1,285	1,093.	2.9	516.	47	3,675	46
3/0	200	2	2.38	4.44	5,350	1,814.	4/0	205	1.87	2.74	1,550	1,265.	2.5	549.	43	3,800	38
4/0	230	2½	2.88	6.51	7,730	2,508.	250	230	2.04	3.27	1,840	1,522.	0	986.	65	5,890	50
250	255	2½	2.88	6.51	8,190	2,883.	300	255	2.16	3.66	2,080	1,751.	0	1,132.	65	6,110	44
300	285	2½	2.88	6.51	8,700	3,171.	350	285	2.27	4.04	2,325	1,870.	0	1,301.	70	6,375	38
350	310	3	3.50	9.62	10,860	3,752.	400	305	2.37	4.41	2,560	1,998.	–1.6	1,754.	88	8,300	54
400	335	3	3.50	9.62	11,370	4,053.	500	355	2.56	5.14	2,990	2,260.	6.0	1,793.	79	8,380	46
500	380	3	3.50	9.62	12,390	4,748.	600	395	2.79	6.11	3,545	2,615.	3.9	2,133.	82	8,845	36
700	460	3½	4.00	12.57	15,930	6,459.	750	455	3.02	7.16	4,175	3,151.	–1.1	3,308.	105	11,755	43

* Based on 1956 N.E. Code ** 90°C Conductor—40°C Ambient. Note—Comparison of 75°C RHW and 90°C Butyl K/W Spec. 107. Weights and prices for 1000 ft. Current prices, 4-29-59.
(1) Savings based on increased cost of copper and steel over aluminum cable.

1. LESS COST

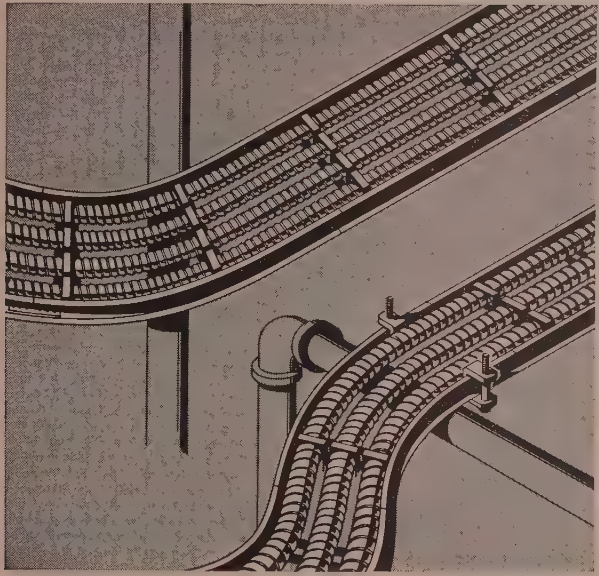
You realize important savings on *materials* with KW Aluminum Interlocked Armor Cable because (1) it gives you greater current-carrying capacity per dollar, (2) the nature of its aluminum armor eliminates costly conduit. Also, you save on *costly labor* because KW's corrosion resistant aluminum armor holds upkeep to a minimum, even in highly corrosive areas.

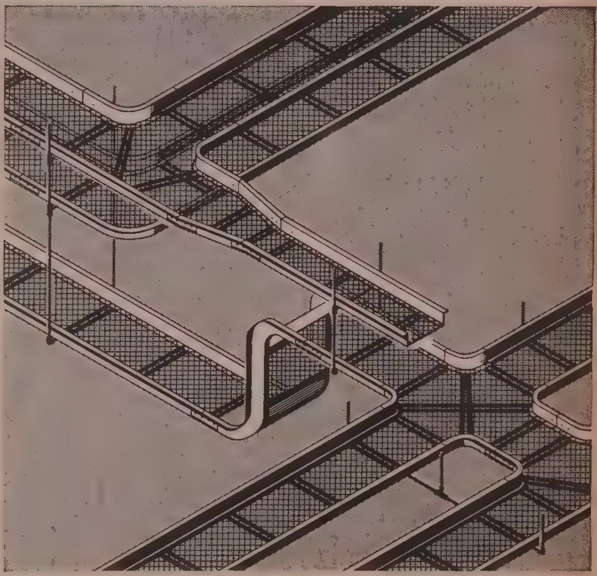
2. LESS WEIGHT

Any interlocked armor weighs far less than heavy, bulky steel conduit. But KW gives you *additional* weight savings because its armor is aluminum—weighing only ⅓ as much as steel or bronze. Moreover, because the conductors are also made of aluminum, they are less than half the weight of copper conductors that carry the same amount of current.

Versatile Use. KW Aluminum Interlocked Armor Cable is the ideal answer for industrial and commercial distribution systems, generator leads and auxiliary cable installations.

For complete information, call the Kaiser Aluminum sales office or KW distributor listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.





3. FASTER INSTALLATION

The light weight and supreme flexibility of KW Aluminum Interlocked Armor Cable mean easier handling, cut installation time in half. It can easily be bent horizontally or vertically around impeding objects and laid in longer lengths, eliminating the need for frequent splicing. In addition, because its diameter is less than conventional conduit systems, compact KW cable can bring space savings of up to 54%.

4. SPEEDIER MODIFICATIONS

KW Aluminum Interlocked Armor Cable may be laid on readily accessible racks, trays and troughs . . . or hung from a messenger. It is a quick and simple matter to expand KW Interlocked Armor Cable systems to meet increased power requirements which may arise after installation.

KAISER ALUMINUM*

"If It Carries Current, K/W Carries It!"

*TRADEMARK KAISER ALUMINUM & CHEMICAL CORPORATION

See "MAVERICK" • Sunday Evenings, ABC-TV Network.
Consult your local TV listing.

TRADE ARRO MARK

MACHINE SCREW ANCHORS

Easy to install . . . requires shallow hole . . . fixture can be removed and replaced without loosening anchor . . . a few hammer blows set anchor firmly . . . conical-shape nut expands lead sleeve to provide strong holding power . . . widely used by electricians, plumbers, carpenters, ornamental iron workers, maintenance men, awning and sign men and other tradesmen.

Cutaway drawings show how setting tool expands lead sleeve around conical nut.

HAMMERLESS SETTING TOOL

Expander hammerless setting tool for easy installation of Arro Machine Screw Anchors in hollow tile, bottomless or weak-bottom holes.

THE TRADE ARRO MARK LINE OF MASONRY ANCHORING AND DRILLING DEVICES

See your industrial, hardware or electrical supplier

ARRO EXPANSION BOLT COMPANY
DEPARTMENT D, P.O. BOX 388, MARION, OHIO

Fluorescent Fixture (29)

A new industrial fluorescent lighting fixture, the "Mark V Industro-lux" contoured reflector luminaire, is designed to RLM standards. Reflector has five heavy die-formed ribs every 48 in. Fixture can be hung individual or in continuous rows. A wide selection of mounting accessories of the gripper type is available. Reflector has an all white porcelain finish.

Smoot-Holman Company, P. O. Box 4097, *Inglewood, Calif.*

Rotary Limit Switch (30)

New lightweight, cast aluminum, NEMA 7 enclosures now permit the housing of rotary limit switches with gear ratios ranging from 5:1 to 1750:1. Positive independent cam settings allow adjustments of one cam without upsetting the position of the other. UL approved Micro switches have single pole, double throw, contacts for reversibility of control circuits. Switch is rated at 125-, 250- and 460-volt, 15 amp, ac., 125 volt, ½ amp, dc, 250-volt, ¼ amp. dc.

Gemco Electric Co., 25685 *West Eight Mile Road, Detroit* 40, *Mich.*

Generator Sets (31)

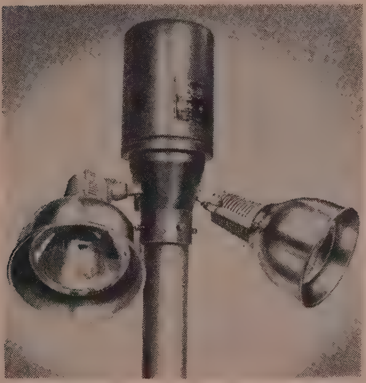
Three new 3600 rpm portable gasoline electric plants featuring an automatic idling control. All units, 1500-, 2500- and 3500-watt, feature an automatic "Econ-o-mizer" idling control which permits the plant to idle until a load of 100 watts or more is applied, at which time it revs up to operating speed and voltage. When load on plant is removed, it again drops back to an idling speed. All units are powered by 4-cycle air-cooled Briggs & Stratton engines. Standard equipment includes stop-switch, pilot light, vibration dampers, rope or recoil starter, two 15-amp grounding type receptacles and one 30-amp, 3-wire twistlock receptacle (2500 and 3500-watt models) and carrying handle or dolly.

Winpower Mfg. Co., Newton, Iowa

Range Hood (32)

The "Hi-Flow," a new ductless range hood, features a rechargeable coated-type filter and fresh air discharge through vents placed at top of hood. The "Hi-Flow" filter, part of a dual filter system that also includes an aluminum grease filter, has an adhesive coating, which absorbs odors, dust and pollen. The coated filter is rechargeable by spraying with a coat of fresh adhesive. Both filters are built into the hood. It comes complete with cord and plug and a built-in junction box for wiring in permanent installations. Available in 30-, 36- and 42-in. sizes, in four finishes.

Berns Air King Corp., 3050 N. Rockwell St., Chicago 18, Ill.



Floodlight (33)

New mercury vapor floodlight features a patented full-floating socket construction that adjusts automatically to variations in lamp sizes and shapes to insure a weather-seal with all makes of R-60 reflector lamps—mercury vapor in the 400-watt size, as well as 750-1000-watt incandescent. Floodlights are available with lamps, transformers, and a variety of devices for pole top, surface or wall mounting singly or in clusters. Fixtures are fully ventilated and are UL approved for outdoor service. Bulletin B-19 is available.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.

Chem Marine
TRADEMARK
IT PAYS TO HAVE GOOD CONNECTIONS
HUBBELL
REG. U.S. PAT. OFF.
a complete new line of exceptionally rugged wiring devices that withstand adverse conditions
LISTED UNDER REEXAMINATION SERVICE UNDERWRITERS' LABORATORIES, INC.
UL

RESISTS CORROSION

This new super line of "Chem Marine" devices are engineered from corrosion resistant materials capable of withstanding the harmful effects of moisture, brine, grease, oils and many acids. They are designed for industrial applications such as plating rooms, shipping platforms, yards, shops, warehouses, or wherever corrosion or chemical action is a problem.

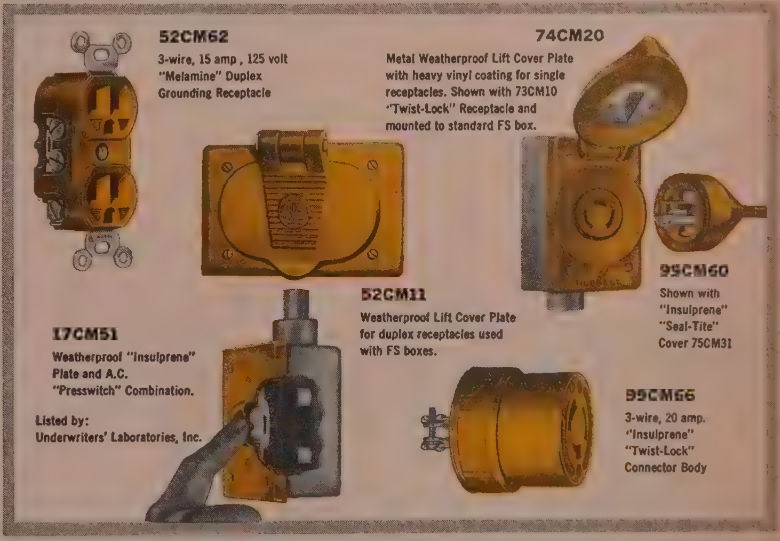
Special Materials:

"INSULPRENE"—a Du Pont neoprene compound.

"MONEL® METAL"—Reg. Trademark of INCO.

"MELAMINE"
"CYMEL®"—Reg. Trademark of Am. Cyanamid

HEAVY NICKEL-PLATED CURRENT CARRYING PARTS.


52CM62
3-wire, 15 amp, 125 volt "Melamine" Duplex Grounding Receptacle
74CM20
Metal Weatherproof Lift Cover Plate with heavy vinyl coating for single receptacles. Shown with 73CM10 "Twist-Lock" Receptacle and mounted to standard FS box.
52CM11
Weatherproof Lift Cover Plate for duplex receptacles used with FS boxes.
17CM51
Weatherproof "Insulprene" Plate and A.C. "Presswitch" Combination.
Listed by: Underwriters' Laboratories, Inc.
95CM60
Shown with "Insulprene" "Seal-Tite" Cover 75CM31
95CM66
3-wire, 20 amp. "Insulprene" "Twist-Lock" Connector Body

"Chem Marine" devices are identified by their bright yellow color and a few representative items are illustrated above. For complete information contact the "Chem Marine" Department. —

HARVEY HUBBELL, INCORPORATED
BRIDGEPORT 2, CONNECTICUT, In Canada: Scarborough, Ontario

Electricians! Maintenance Men!

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ELECTRICAL-ELECTRONICS
REFERENCE SET
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Keeps You Up-To-Date . . .
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Here's the easy, practical way for Electricians to keep up with modern electronic equipment and new techniques he needs to get ahead. With Coyne's new 2-volume set you learn by reference on the job. You get simple explanations, hundreds of working diagrams and trouble-shooting methods on everything from wiring to latest electronic controls. No complicated math; no time wasted. Costs nothing to see for yourself.

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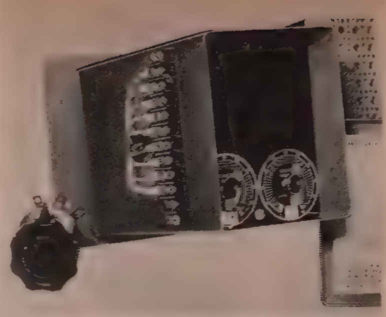
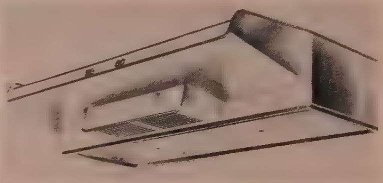


Voltage Regulator **(34)**

This static voltage regulator is of the magnetic amplifier type. "Fincor" F-26 may be used to regulate the output voltage of any 50-60 cycle generator or exciter requiring a dc field supply of up to 1.8 amps at 125 volts or less. Selenium rectifiers are standard, but sealed silicon rectifiers are available for installations in corrosive atmospheres. An input power of 208 to 240 volts, 60 cycles, is required. This may be obtained either directly from the generator output, through generator taps or from a transformer if 208-240 volts is not available. The regulated output voltage can be varied by an externally mounted rheostat.

Fidelity Instrument Corp., 1000 *E. Boundary Ave., York, Pa.*



Range Hood **(35)**

New 60-series duct-free range hood is for apartments or interior walls far from exterior outlets. Unit is 7½ in. high. A scientifically designed air flow passes air over activated charcoal filter. Filters can be removed, cleaned, or replaced. Available in three standard lengths of 30, 36 and 42 ins and in two finishes—N-Copper and SC satin chrome.

Fasco Industries, Inc., Rochester 2, *N. Y.*

Service Vehicle **(36)**

A new service vehicle for work in manholes where electric power, dewatering pump and compressed air is used. Space is provided for a portable ventilating blower, which can direct heated air from the engine into the manhole. It operates from the generator. Engine generator, rated 3500 watts, 115 volts, 60 cycles, single phase, is driven by an air cooled engine. Fuel may be LP gas or gasoline. Generator panel has power outlets, meters and switches for lights. Water pump is non-clogging, self-priming, centrifugal, with 3-in. suction and discharge. Complete unit is enclosed in a steel house and is trailer mounted. Flood and red warning lights are mounted on an extendible support. Bulletin ST 60 is available.

United States Motors Corp., Oshkosh, Wis.

Lighting Unit **(37)**

The new outdoor line of Imperialites consists of a wide variety of colonial and modern styled post lanterns in frosted, clear or textured crystal glass; coach-style and modern wall lanterns and a wide selection of ceiling hall, porch or utility outdoor fixtures. Model 421 is a black and brass aluminum post lantern, 11½ in. high with 21-in. spread; fits standard 3-in post. Opal glass with 150-watt lamp.

Emerson Electric Mfg. Co., 81000 *Florissant Ave., St. Louis* 36, *Mo.*

Plug and Receptacle **(38)**

Tamperproof plug and receptacle for taking power from fixtures can be installed in new or existing street lighting standards or other electrical fixtures. Designed primarily for use with portable lighting, signal, and power equipment, plug and receptacle protect operating personnel and public from live leads and exposed contacts. Receptacle can be energized only by inserting and turning the mating key plug. They are rated 30 amps at 115 volts or 15 amps at 230 volts for 2- or 3-wire circuits. Hermetic sealing and Neoprene insulation protects units against environmental conditions, and explosion-proof design permits use in hazardous areas.

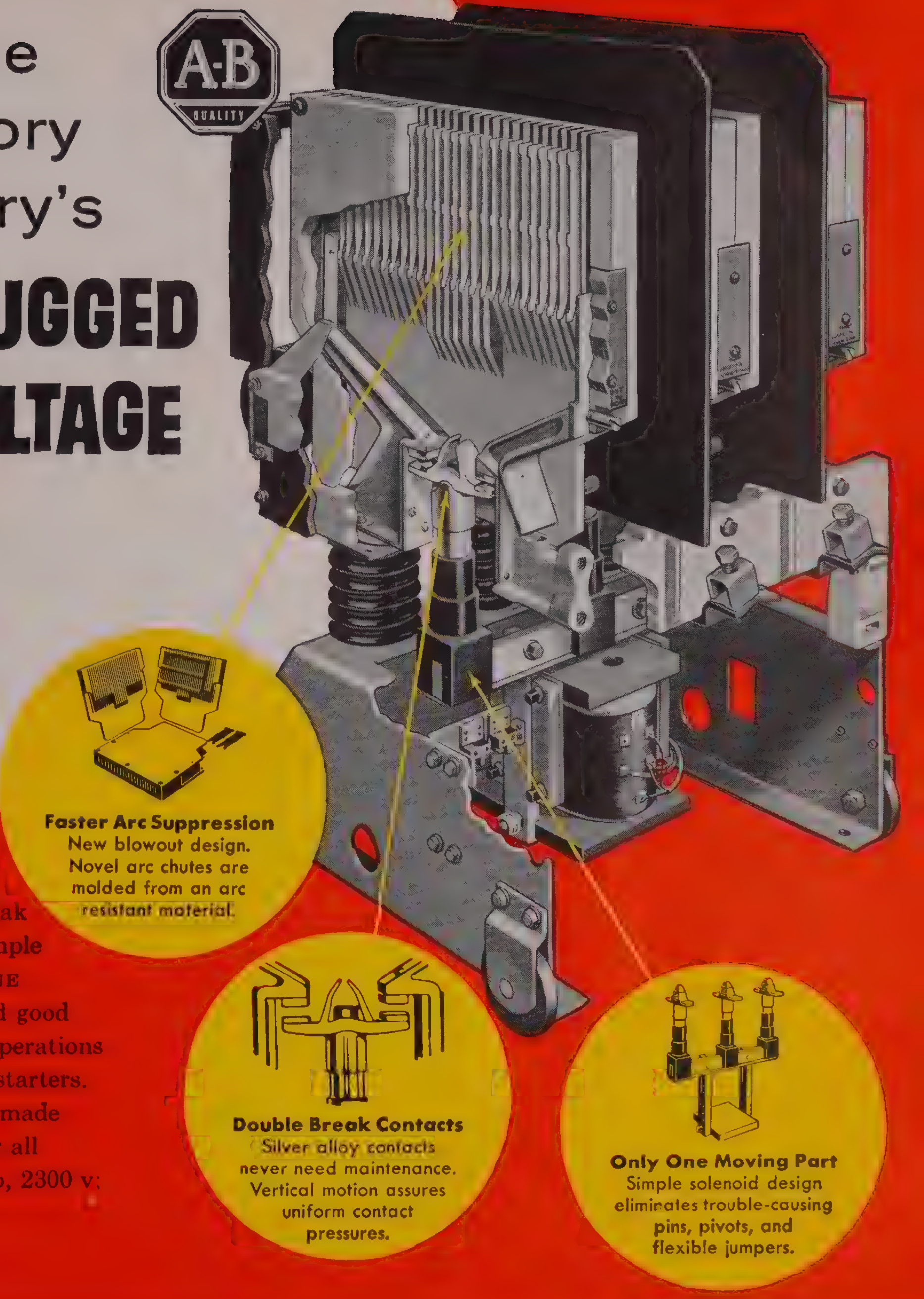
J. B. Nottingham & Co., Inc., 441 *Lexington Ave., New York* 17, *N. Y.*

Here's the inside story of industry's

MOST RUGGED HIGH VOLTAGE SWITCH

THIS SOLENOID AIR BREAK CONTACTOR IS THE HEART OF THE A-B STARTER LINE

A tremendous operating life has been built into these new A-B high voltage, air break starters by using the same simple solenoid design—with only ONE moving part—that has proved good for millions of trouble free operations in Allen-Bradley low voltage starters. A-B high voltage starters are made for all types of service and for all types of motors up to 1500 hp, 2300 v; 2500 hp, 4600 v. Send for Publication 6080, today.

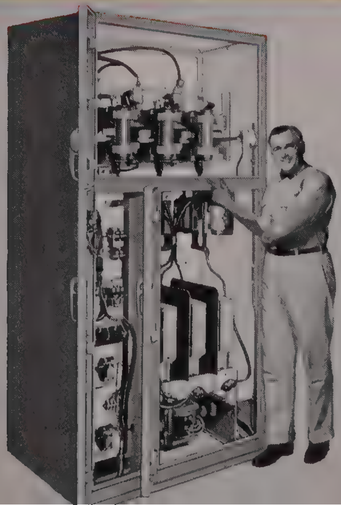


Faster Arc Suppression
New blowout design. Novel arc chutes are molded from an arc resistant material.

Double Break Contacts
Silver alloy contacts never need maintenance. Vertical motion assures uniform contact pressures.

Only One Moving Part
Simple solenoid design eliminates trouble-causing pins, pivots, and flexible jumpers.

5-60-RM



A-B High Voltage Starter with Air Break Contactor

Bulletin 1159 high voltage air break, across-the-line induction motor starter in NEMA Type 1 enclosure. All Allen-Bradley high voltage starters are equipped with current limiting fuses with interrupting capacities of 150,000 kva at 2300 v; 250,000 kva at 4600 v.

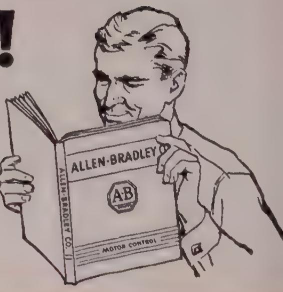
ALLEN-BRADLEY

Member of NEMA

***Quality* Motor Control**

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Some more special controls that are "standard" with Allen-Bradley!



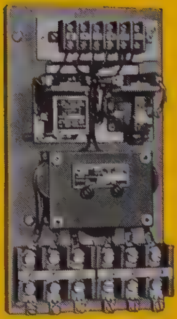
Even Khrushchev couldn't claim a more complete line!

Phase Failure Phase Reversal Relays

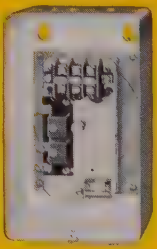
The Bulletin 812 Style RF relay responds to *all* open phase conditions on a branch motor circuit and immediately removes the motor from the line. Also, the motor is disconnected when a phase reversal occurs anywhere in the system on the line side of the relay. "Fail safe" design.

Phase Failure, Style F covers f.l. currents from 1.5 to 300 amp in 4 sizes. Coils to 600 v, 60 cycles.

Phase Reversal, Style R made with coils for 110, 208/220, 440, 550 v for either 50 or 60 cycles.



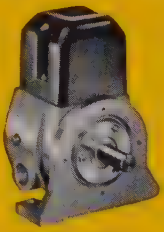
Bulletin 812 Style F



Bulletin 812 Style R

Zero Speed Switch

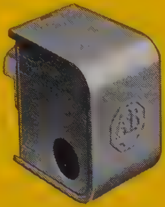
Used for "plugging" duty, these switches prevent coasting and bring squirrel cage motors to a sudden stop. Also used to prevent application of reverse power before motor comes to a full stop. Adjustable operating speed.



Bulletin 808

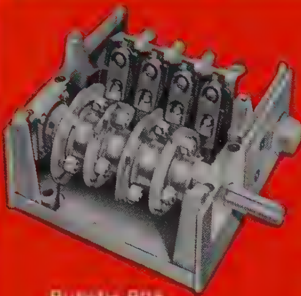
Low Pressure Switch

Especially designed for domestic water pump service and commercial air compressor service. These inexpensive compact switches offer pressure ranges from 15 to 200 psi.



Bulletin 830

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.



Bulletin 803

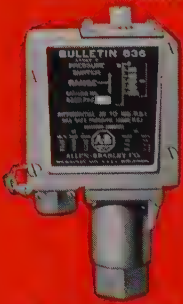
Rotating Cam Limit Switches

Heavy-duty pilot controls used on rotating machines to initiate functions at any point of rotation. Made with up to 12 individually adjustable, independent circuits.

Bulletin 806

Foot Switches

Built for toughest service. Has maintenance free, snap-action contacts. Extended base prevents tipping. Made with hood (left), with top guard and without guard.



Bulletin 836 Style T

Pressure Controls

Oiltight enclosure for machine tool hydraulic systems operating at pressures up to 5000 psi. Operating pressure and differential are adjustable. Indicator shows trip point. Silver contacts never need service attention.

Bulletin 837 Style A

Temperature Controls

Newly designed bellows provides lower differentials. Rugged construction permits continuous cycling from zero to maximum setting. Vibration or mounting angle will not affect accuracy of operation. Temperature ranges from −150°F to 490°F

In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Lighting Fixture (39)

A new die cast aluminum line of vaportight industrial lighting fixtures. A special white coating designated as PEC-9 gives added protection of metal parts against the corrosive effects of salt spray, acid fumes, strong caustics and organic liquids. Fixtures are available in 100- and 200-watt sizes with or without reflectors of the dome, shallow bowl, deep bowl and angle types. Both wattage sizes take the same interchangeable straight and bracket adapters for wall and ceiling mounting. Adapters are available for pendant, universal hub aluminum box and 4-in. outlet boxes. Heat resistant glass globes are standard in a choice of colors. AO-series fixtures are UL and CSA approved.

Pyle National Company, 1334 *North Kostner Ave., Chicago* 51, *Ill.*

Motors (40)

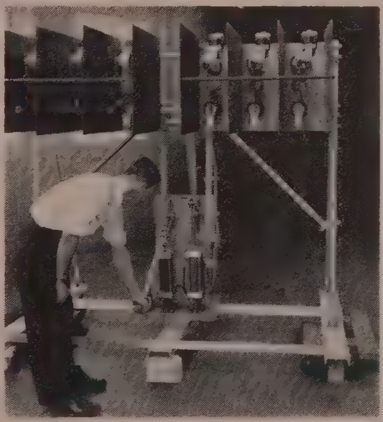
New high-speed squirrel cage induction motors are now being offered in 100-5000 hp, 514-3600 rpm, frames 584-11320. A one piece, wrap-around steel plate cover running the full length of the frame extends below the center-line of motor on each side to provide natural drip-proof protection and to increase the rigidity of frame structure. Double end ventilation system provides maximum cooling, permitting full utilization of motor capacity. Motors are available with silicone rubber as well as Class A, B and H insulations.

Ideal Electric and Manufacturing Co., Mansfield 28, *Ohio.*

Transformer (41)

A new universal network transformer designed for either vault or subway applications is available in ratings of 300, 500, 750 and 1000 kva at 5, 15, 25 and 34.5 kv. Improved corrosion protection for critical welded areas is provided by a better film thickness of paint over the smoother and more uniform automatically welded seams of the unit's coolers. It retains all the advantages of the standard Space-Miser construction — small size, round-cornered tank and Yukon coolers.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*



Automatic Mechanism (42)

A dual cylinder, double throw automatic switch transfer mechanism, activated by stored energy, was specially designed for installation in an area encompassing hospitals, freezer storage plants, and other power users for whom an extended service interruption could be disastrous. Mechanism opens preferred source disconnect switch and closes another to instantly transfer to an emergency power source when power failure occurs. A timing device selects from 0 to 30 seconds time delay to allow circuit breakers to operate properly before triggering the preferred cylinder. Two 3-phase switches are equipped with Powerupters (compact enclosed-type interrupters) and have insulating barriers between the phases.

Delta-Star Electric Division, H. K. Porter Company, Inc., Chicago, Ill.

YOUR SHIRT

....and how to lose it!

We have a carefully considered little write-up which is a guaranteed method for you (Mr. Contractor) to lose your shirt! Perhaps you would like to have a copy of it... it's free. Also available is a sure-fire method to keep your shirt on -- and make a profit, too. Take your choice -- or get both -- just fill in the coupon below.

HENDERSON-HAZEL CORP. Dept. A-03
13601 EUCLID AVENUE • CLEVELAND 12, OHIO

Gentlemen: Please send me

☐ "YOUR SHIRT and how to lose it!"
☐ Details about "National Price Service"
☐ Both

Name__________
Title__________
Company__________
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City______ Zone____ State____

NPS National Price Service
HENDERSON-HAZEL CORP.

13601 EUCLID AVENUE • CLEVELAND 12, OHIO

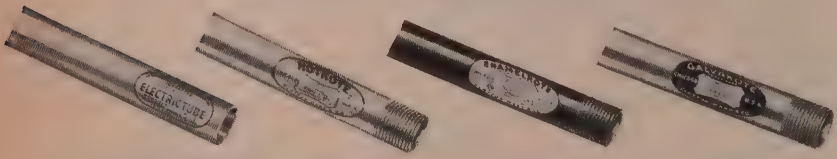
. . . it's so easy to bend!

CLAYTON MARK RIGID STEEL CONDUIT

. . . HAS MORE SUPERIOR FEATURES

Clayton Mark Rigid Steel Conduit is made of special quality steel that bends, cuts and threads easier. Threads on pipe, elbows and couplings are accurately-cut standard gauge and then galvanized to prevent rusting. A super-smooth, interior surface speeds wire fishing while the new zinc plating process gives a heavier uniform finish for longer life.

BUY THE BRAND THAT HAS OFFERED MORE SUPERIOR FEATURES SINCE 1910



ELECTRICTUBE EMT

The satin-finish, close-grained, electro-galvanized exterior surface has exceptional corrosion-resistant life. The super-smooth interior surface permits easy feeding, pulling around bends and re-feeding of wires with less time and effort.

HOTKOTE

Special hot-galvanizing process is employed to coat exterior and interior surfaces. These surfaces are then covered with a transparent lacquer and baked. This provides a permanent bond with concrete and permits easy pulling of wires.

ENAMELKOTE

Both exterior and interior surfaces are coated with the highest grade black enamel which is specially prepared and scientifically baked on to insure adhesion and prevent flaking in bending. Wires pull through with extreme ease.

GALVAKOTE

Exterior surfaces are coated with pure zinc evenly deposited by the electro-plating process. It will not crack under severe bending. Interior surfaces are evenly coated with a baked enamel which is extremely smooth and easy to work with.

AVAILABLE IN ALL 50 STATES

CLAYTON MARK
AND COMPANY
1903 DEMPSTER STREET • EVANSTON, ILLINOIS • U.S.A.

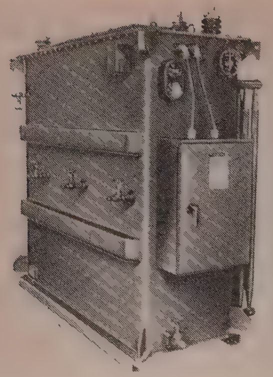
PUMPS WATER WELL SUPPLIES CONDUIT UNIONS TUBING

Wires fish easier and faster!

REATER INHERENT AND
TRUCTURAL STRENGTH

NO TARRING OR SPECIAL EXTERIOR
PREPARATION NECESSARY

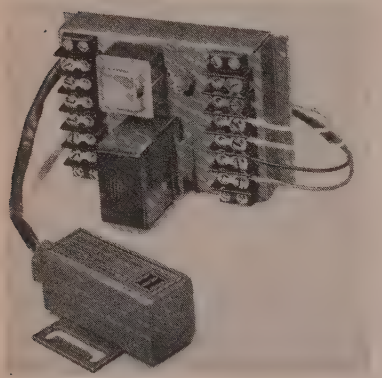
TAKES ROUGHEST PUNISHMENT
DURING CONSTRUCTION



Regulators (43)

New feeder-voltage regulators, type SVR-FT, for use wherever a 3-phase load is to be regulated to a desired voltage level. The 60-cycle, 3-phase, step-type regulators are rated 500 and 750 kva for 8.66- or 13.2-kv circuits. Units are completely automatic and self-contained. Some of the features include 16-step voltage regulation over a 20% range. New type CVR relay incorporates both voltage regulating device and time delay. Direct-drive tap changer requires one second for a 1¼% correction; traverses full buck to full boost in 13 seconds and gives controlled contact speed. Each phase has its individual tap changer in a separate compartment.

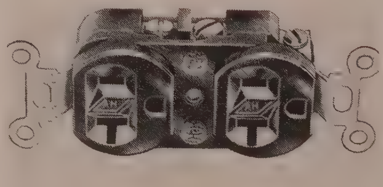
Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.



Switch (44)

A new proximity switch designed for use as limit, interlock, counter or indicator sensors under unfavorable conditions. Switch consists of a sensor and a separate transistorized amplifier with plug-in relay. Sensor detects magnetic material without physical contact and feeds an electrical output to the remotely located bi-stable amplifier. Amplifier operates the double-pole-double-throw relay, which is wired to circuit in same manner as conventional limit switch. Two components of unit may be located up to 150 ft apart without use of shielded wire. It can be energized from 115 volts 60 cycle. Data Sheet 163 is available.

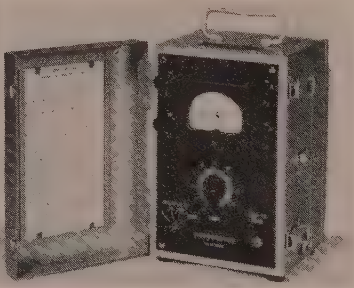
Micro Switch Division, Minneapolis-Honeywell Regulator Co., Freeport, Ill.



Duplex Receptacles (45)

New 20-amp, 125-volt duplex grounding receptacles and caps are supplied in 2-pole, 3-wire grounding types. They are approved for use as stated in Article 210, Section 210-21 of the 1959 NEC. Equipped with two circuit break-off fins, they are offered in brown bakelite, ivorylite or with weatherproof plates, with or without padlock. Design features include a red strap for 20-amp identification and double grounding terminals. Caps are made of rubber or armor over rubber. Both receptacles and caps are listed as standard by UL.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Instruments (46)

The new Vibroground series of instruments are for measuring the resistance of electrical grounds in electronic, telephone, and electric power circuits. The series include three models, all of which provide direct reading of ohms resistance to an earth ground. Direct reading ranges as low as 0.3 ohms and up to 0-2000. Bulletin 1-2 is available.

Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

Now engineered for longer life!

Sylvania cuts starter failures by 98%!

What's the secret? Every Sylvania starter has a *ceramic* condenser! Other starters have paper condensers. Heat, cold, moisture knock 'em out. But not Sylvania starters!

HERE'S PROOF! In a two-year test in one manufacturing plant (installations were two-lamp, 40-watt industrial type fixtures), Sylvania fluorescent starters had

only 1 failure out of 340 starters

Conventional starters with paper condensers had

51 failures out of 330 starters

No wonder Sylvania can sell the only starters with an *exclusive* Light Insurance Policy. *Guaranteed* performance, or your money back! It's your assurance of lowest TCL (Total Cost of Lighting), which means cost of lamp power plus maintenance.

This is Sylvania research at work for you—consistently in the lead in lighting! For all types of starters, call your Sylvania representative, or write:

Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 1190, Station "O," Montreal 9.

SYLVANIA

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

We're still waiting...

TO GIVE YOU YOUR MONEY BACK!

The offer is still open! Every Sylvania fluorescent we sell is covered by Sylvania's exclusive Light Insurance Policy. Have you read it? It *guarantees* Sylvania fluorescents will perform *better* than the brand you are now using, in your opinion—or your money back!

Sylvania Fluorescents up to 14% brighter. Up to 14% more light than other brands from the first minute the fresh lamps are turned on. In *maintained* brightness you get as much light as 108 standard fluorescents for every 100 Sylvania lamps you install. And this is true hour after hour after hour after hour. You save on TCL (Total Cost of Lighting), which means cost of lamp plus power plus maintenance.

Last longer, less maintenance. Cost of the lamp itself represents only one tenth of the Total Cost of Light. The balance is power consumption and maintenance. Sylvania fluorescents not only burn brighter on the same amount of power, they last longer, require far less replacements.

Want information? Want better light? Call your Sylvania representative. Or write us:

Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P.O. Box 1190, Station "O," Montreal 9.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

GENERAL SYSTEM

Solve PROBLEMS that are Over Your Head with BAKER SCAFFOLDS

● Most off-the-floor work requiring a scaffold is within a 12 foot height. A single BAKER SCAFFOLD has a platform that is adjustable every 3 inches and immediately places a man within easy reach of any work up to this maximum height. For higher levels of work, additional BAKER SCAFFOLD units may be stacked to reach the required height. Any off-the-floor work is as simple as that and—BAKER SCAFFOLDS can be assembled by one man within 90 seconds. BAKER SCAFFOLDS are easily transported through doors, around corners. They are designed to move over objects in the floor—they have no cross braces and—when you want to store them, they occupy no more space than an ordinary step ladder. You'll save time and money with a BAKER SCAFFOLD. Write today for more complete information.

LISTED UNDER RE-EXAMINATION SERVICE UNDERWRITERS' LABORATORIES, INC.

BAKER SCAFFOLDS
DESIGNED FOR PORTABILITY—BUILT FOR DURABILITY

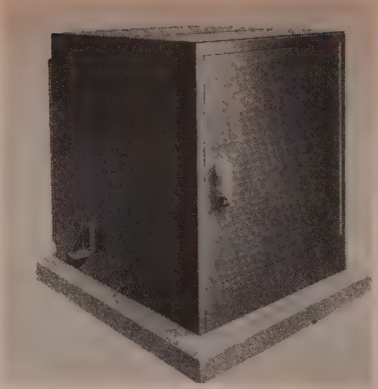
Write for
Baker Scaffold
Bulletin # 603

BAKER-ROOS, INC.
P. O. Box 892, Indianapolis 6, Indiana

Gentlemen: Send the folder described on Baker Scaffolds without obligation. ECM

Name____________________
Organization____________________
Address____________________
City__________ State__________

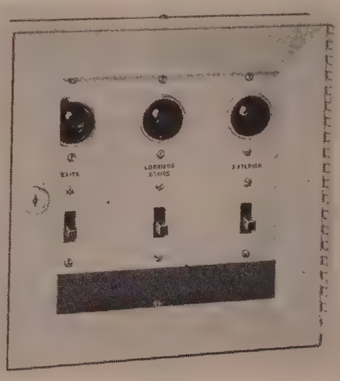
DISTRIBUTORS IN PRINCIPAL CITIES



Transformers (47)

A new line of Sub-Urban pad mounted distribution transformers is designed for surface mounting on a concrete pad, through which both the primary and secondary underground cables are brought into a tamper-proof enclosure for connection to terminals. They are for residential and commercial developments employing underground distribution systems, as transformer can be screened with shrubbery so as to blend into the landscaping of the area. Transformers are built in single-phase ratings 25 through 167 kva and 3-phase ratings 75 through 500 kva, 15 kv and below.

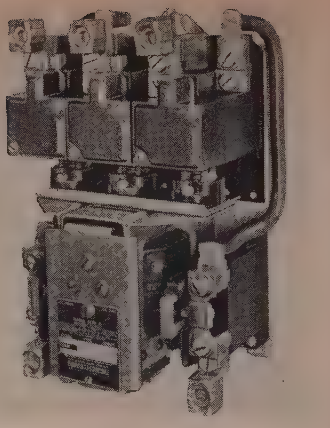
Wagner Electric Corp., 6400 *Plymouth Ave., St. Louis* 14, *Mo.*



Control Cabinet (48)

Control cabinet for emergency lighting systems is designed especially to meet those codes which require that emergency controls be placed in the entrance halls and lobbies of schools, theaters, churches, and other places of assembly. Unit is available in stainless steel with capacities up to 18 signal lights and switches. Available in 1, 2, 3, 4 or more gang models.

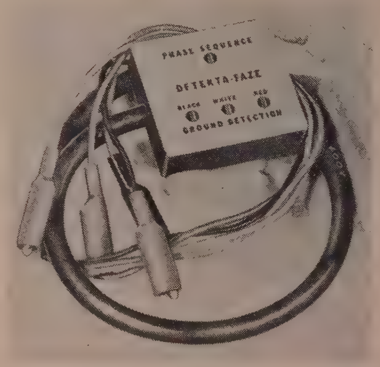
Morris Kurtzon, Inc., 1420 *South Talman, Chicago, Ill.*



Starter (49)

A compact new NEMA Size 4 starter features trip-free melting alloy overload relays with unit-construction thermal units, or adjustable bimetallic overload relays with hand and automatic reset. Up to four double-circuit interlocks may be added. Dimensions are 12⅜ by 8¼ by $6\frac{3}{32}$ in.

Square D Company, 4041 *North Richards St., Milwaukee* 12, *Wis.*



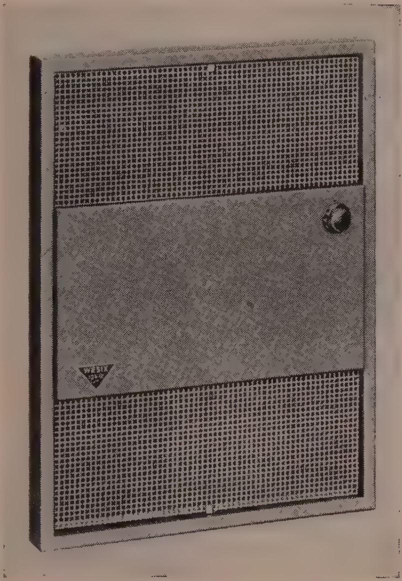
Instrument (50)

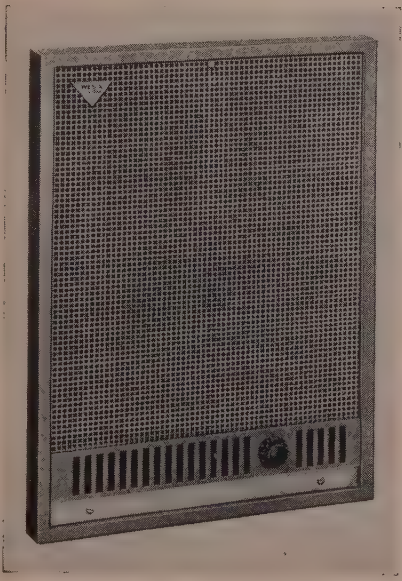
The Detekta-Faze, a combination phase sequence indicator and ground fault detector, enables you to predetermine the direction of rotation for any given motor without starting the equipment. Unit, measuring 2¾ in. by 2½ in. by 1 in. is completely self-contained; only one light is used for phase detection, and that light is either on or off depending upon direction of rotation. It can be used on 2-phase, 3-wire systems and 3-phase, 3- and 4-wire systems, within an operating range of 200 to 500 volts, 60 cycles ac. Ground fault detector built into unit is effective for 2- or 3-phase 3-wire ungrounded systems.

Glo-Lite Instrument Co., 428 *Peshine Ave., Newark* 12, *N. J.*

WESIX WIRE

NEW HEATING UNITS DEMONSTRATED





To be demonstrated at all exhibit hours at the exposition are the most popular models of the new Wesix line of residential heating units combining the finest in decorative techniques with economical installation.

WESIX TO HOLD SALES CLINICS AT ELECTRIC HEAT EXPOSITION

Equipped with special facilities at booths 121 and 123 at the first National House Heating Exposition in Chicago March 21-23, America's pioneer manufacturer of electric space heating equipment will hold a series of electric heat clinics, passing on tips and general information based on their 40 years of electric heat leadership.

Under the direction of Harold Wilde, eastern division sales manager for Wesix, the clinic presentations will feature slides, film and other visual aid demonstrations designed to digest important selling and installing information in the shortest possible time. Also officiating will be members of the staff of Williamson and Co., manufacturers' representatives for the Wesix company in the Chicago area.

Topics will include the following: "Thirty Years of School Heating," a study of institutional heating installations that actually go back for more than thirty years—with the original equipment still in service today. Suggestions will be included on making this information pay off in the huge school expansion period predicted for the 1960's; "How Electric Space Heating can Save Dollars for Industry," a review of the many ways that electric heat can pay its own way in heating factories, offices and shops; "New Industries Need New Electric Process Heating," which will cover the many new heating needs of plastics, electronics and allied industries as well as the new and refined electric process heating devices ready to serve them; "The Perfect Home Heating Job—Something to Aim At," which will cover the design and installation of an actual Gold Medallion home which can be a yardstick for perfection in modern electric heating.

SCHEDULE OF CLINICS AT HEATING EXPOSITION

Booths 121 and 123, First National Electric House Heating Exposition, Hotel Sherman, Chicago, Ill.

"Thirty Years of School Heating"
Monday, March 21, 3:30 pm

"How Electric Space Heating Can Save Dollars for Industry"
Tuesday, March 22, 3:30 pm

"New Industries Need New Electric Process Heating"
Tuesday, March 22, 8:00 pm

"The Perfect Home Heating Job; Something to Aim At"
Wednesday, March 23, 2:00 pm

CLINIC TRANSCRIPTS AVAILABLE BY MAIL

Complete illustrated copies of the Wesix clinics to be held during the house heating exposition are available to members of the electrical and building industry unable to attend the show. Simply fill out the coupon below naming the subjects of your choice and material will be sent you at no charge.

MAIL TO: WESIX ELECTRIC HEATER CO.
390 First Street, San Francisco 5

NAME..........
ADDRESS..........
CITY.......... STATE..........

SCHOOL HEATING ☐ SPACE HEATING FOR INDUSTRY ☐
PROCESS HEATING ☐ PERFECT HEATING JOB ☐

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NEARBY SERVICE on Black & Decker tools.

Black & Decker maintains 50 factory service branches plus authorized service stations to give your B&D tools the attention mechanical products need periodically. Keep your B&D tools in top condition, on the job all the time.

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FREE TOOL INSPECTION no cost, no obligation.

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Dept. 1203-S, Towson 4, Md.

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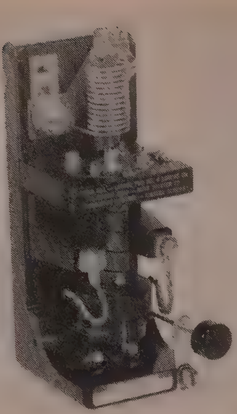


Relay (51)

Thermal overload relay, Type 194A, for use in size 6 and larger starters has been redesigned. The precision thermal overload relay with direct mounted heater element compensates for temperature differences. Relay consists of a helical actuating bi-metal, a helical compensating bi-metal and a heater coil which surrounds the actuating bi-metal. A convenient button is provided for resetting the control contacts after the actuating bi-metal has cooled.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Conversion Unit (52)

A new conversion unit designed to convert EEI-NEMA street lighting heads from incandescent service to mercury vapor lighting. Unit is available for 100-, 175-, 250- and 400-watt lamps operating on line voltages of 240 volts and consists of a unitized package which includes a lamp socket, reflector plate, choke-reactor and anodized mounting bracket. Kits are furnished with six terminal sockets for use with photo cells. Weight of kits range from 4 lbs for 100-watt to 11½ lbs for 400-watt. Watt losses range from six for 100-watt unit to 18 for 400-watt.

Transformer Department, Sylvania Electric Products Inc., Ipswich, Mass.

Transformers (53)

A complete line of compartmented distribution transformers for ground-level installation are called "Lawn-master Pole Star Transformers." Both single-phase and 3-phase ratings are available. They are designed for service on underground distribution systems. Low in height and easily screened by shrubbery and small trees, they are particularly recommended for suburban residential areas, shopping centers and industrial plants. Available ratings include 25 through 167 kva, single phase and 75 through 500 kva, 3-phase, in all standard voltages through 15 kv. Completely self-protected units are available through 100 kva.

Pennsylvania Transformer Division, McGraw-Edison Co., Canonsburg, Pa.

Interlock Kit (54)

A new electrical interlock kit permits field installation of additional contacts in safety switches. Because the interlock contacts make or break ahead of the main switch blades, the interlock can be used within control circuits. Available for all Square D heavy-duty safety switches, the new interlocks are supplied with one normally open and one normally closed contact. Interlock assembly is actuated by the handle of safety switch.

Square D Company, 1601 Mercer Road, Lexington, Ky.

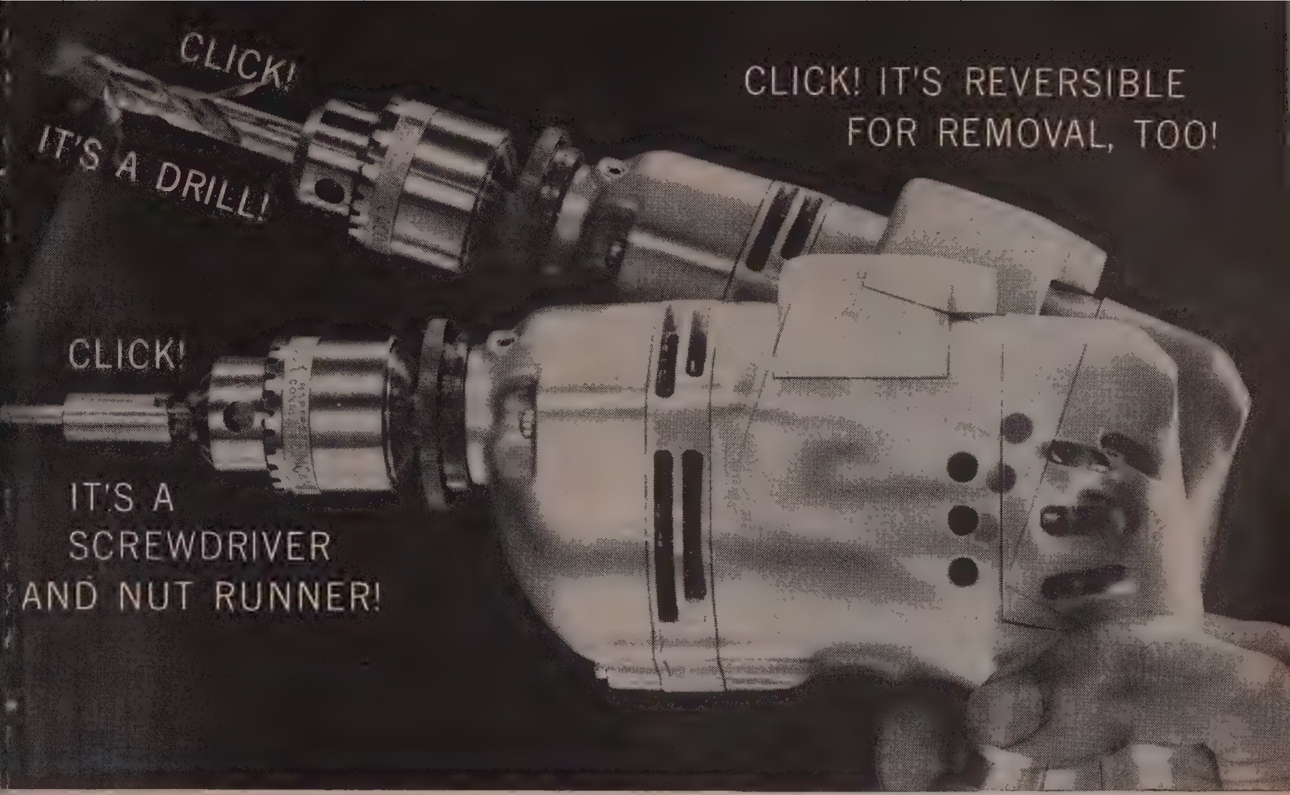
Product Briefs

(55) Two new **silicone dielectric greases** designed for use in applications subjected to temperature extremes have been introduced by the Silicone Products Department, General Electric Co., Waterford, N. Y. . . . (56) Silvray Lighting, Inc., Bound Brook, N. J., has developed a flower-glo **garden light** for homes and commercial use.

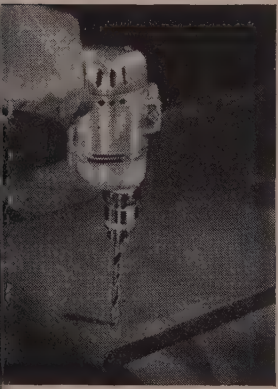
(57) General Electric Co., Schenectady 5, N. Y., has announced the development of a lighter and smaller 50-kvar **capacitor,** called "Compact Isokraft 50."

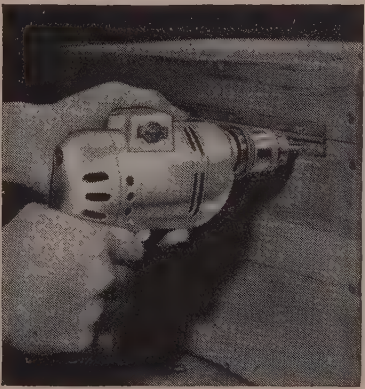
(58) Permacel, New Brunswick, N. J., has released for sale its 423 Teflon **film tape,** a two mil Teflon film with a pressure-sensitive adhesive. . . . (59) A new **glass insulator,** Hemingray 45-T, which reduces maintenance and interruptions in service on all communication lines including railroad and petroleum industry, has been introduced by Kimble Glass Company, Toledo, Ohio.

(60) Lemmerman-Walstedt Company of St. Cloud, Minn., has announced a new **motor holder** made of rustproof steel. . . . (61) Completely redesigned line of single-phase JFR **regulators** has been introduced by Allis-Chalmers Manufacturing Co., Milwaukee, Wis.


CLICK!
IT'S A DRILL!
CLICK! IT'S REVERSIBLE FOR REMOVAL, TOO!
CLICK!
IT'S A SCREWDRIVER AND NUT RUNNER!

Now, a powerful drill plus a screwdriver both in one tool...the NEW B&D 3/8" SCRU-DRILL



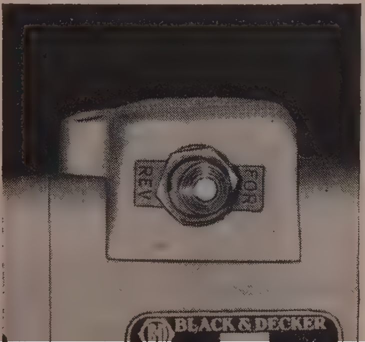


DRILL in metal or wood. Powerful B&D motor gives you full ⅜" capacity in steel, ¾" in wood.

DRIVE screws, nuts or bolts with same tool. Handles #10x1½" wood screws #12 self-tapping.

REMOVE as many as 60 screws, nuts and bolts in 60 seconds. Just flip the reversing switch.

REVERSING switch is *piggy-back* mounted for convenience. You can flip it with your thumb.



SPEED WORK
with this lightweight 2 in 1 tool.

Imagine! A simple turn of the wrist and you switch from drill to screwdriver. A flip of a switch and you're removing screws, nuts and bolts. Remove a bolt, oversize the hole, run a new bolt—as easy and fast as 1-2-3 *and all with the same tool*, your new Black & Decker ⅜" Reversible Scru-Drill!

For woodworking, electrical, plumbing jobs, boat work, general maintenance and many other jobs, try a B&D Reversible Scru-Drill today.

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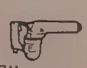
Towson 4, Maryland (In Canada: Brockville, Ont.)

☐ Please arrange a demonstration of B&D Rev. Scru-Drill.
☐ Please send me information on________________.

Name________________Title________
Company________________________
Company Address____________________
City________________Zone____State________


☐ Hammers

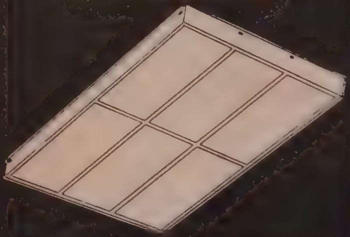
☐ Saws

☐ Drills

☐ Impact Wrenches

PUT YOURSELF
IN A *BETTER LIGHT*
WITH metco Lighting

Power LITE
FLOATING
CEILING



Economical . . . Compact
HIGH LEVEL
Comfortable Illumination

Power-LITE is a pendant type fixture (C.I.E. general diffuse classification) modular in design. It provides high intensity, glare-free, direct-indirect illumination in a large area. Utilizing new high lumen output 15,000 MA lamps, it provides up to 200 to 450 foot-candles of illumination at working levels, comfortably shielded by 45°-45° aluminum or plastic louvers. Power-LITE is a completely satisfactory alternative to suspended ceiling construction that minimizes lighting contrasts by distributing its light on ceiling and walls as well as down on the working area.

Write today for full details and catalog sheet.

SOLD ONLY THROUGH QUALIFIED ELECTRICAL DISTRIBUTORS

METALCRAFT
PRODUCTS CO., INC.
6225 State Road, Phila. 35, Pa.

Catalogs, Bulletins and Engineering Data

(62) LIGHTING FIXTURES. "Current Designs in Lighting," 104 pages, contains installation data, lighting curves, and intensity estimating chart for all types of lighting. The Kirlin Co.

(63) LIGHTED FOUNTAINS. 10-page reprint of article, "Engineering of Lighted Fountains," covers all aspects of the subject, including color data, with curves for water nozzle pressure and flow. General Electric Co.

(64) INSULATED CLEVISES for deadending service drops in commercial or industrial service are covered in new bulletin. Porcelain Products Co.

(65) POWER AND DISTRIBUTION equipment and controls of all types—more than 2500 products—are included with photos and tables in new Redi-Reference condensed catalog, 155 pages. Federal Pacific Electric Co.

(66) TOGGLE SWITCHES and assemblies, including pull-to-unlock, hermetically sealed, rocker-actuated, and other types are covered in Catalog 73d, 32 pages. Micro Switch.

(67) HI-POT TESTS. 12-page application bulletin, "Practical Hi-Pot Testing," covers dc breakdown tests for motors, cables and similar equipment. Associated Research, Inc.

(68) TRANSFORMERS. Bulletin GEA 6108C, 32 pages, gives data on RM medium transformers, single and three-phase. General Electric Co.

(69) SUBSTATIONS. 20-page brochure is designed to assist in planning power center subs, giving complete details on load center transformers, switchgear and other equipment. Uptegraff Mfg. Co.

(70) SYNCHRONOUS MOTORS and vertical magnetic drives are described in two new pieces of literature. Electric Machinery Mfg. Co.

(71) CIRCUIT BREAKERS and other engineered products are completely treated in new 1960 Speedfax catalog. I-T-E Circuit Breaker Co.

(72) EMERGENCY FLOODLIGHTING for use by contractor crews, construction teams and emergency squads is described in Catalog H, 10 pages. Stonco Electric Products Co.

(73) LIGHTING FIXTURES for residential ceilings and walls. Supplement 60A covers new additions to Jaydescent line. Jay Lighting Mfg. Co., Inc.

(74) EXPLOSION-PROOF HOUSINGS. 16-page Bulletin 160 gives complete information on cast-aluminum housings for explosion-proof and weatherproof applications. Adalet Mfg. Co.

(75) MOTOR CONTROL CENTERS. Bulletin SPM-1-1159 features Autocon Plan-Pak units, giving construction details and typical layouts. Automatic Control Co.

(76) BATTERY CHARGING. New bulletin covers installation and use of new MP-3 charge control unit for charging of electrical industrial truck batteries. Exide Industrial Div., Electric Storage Battery Co.

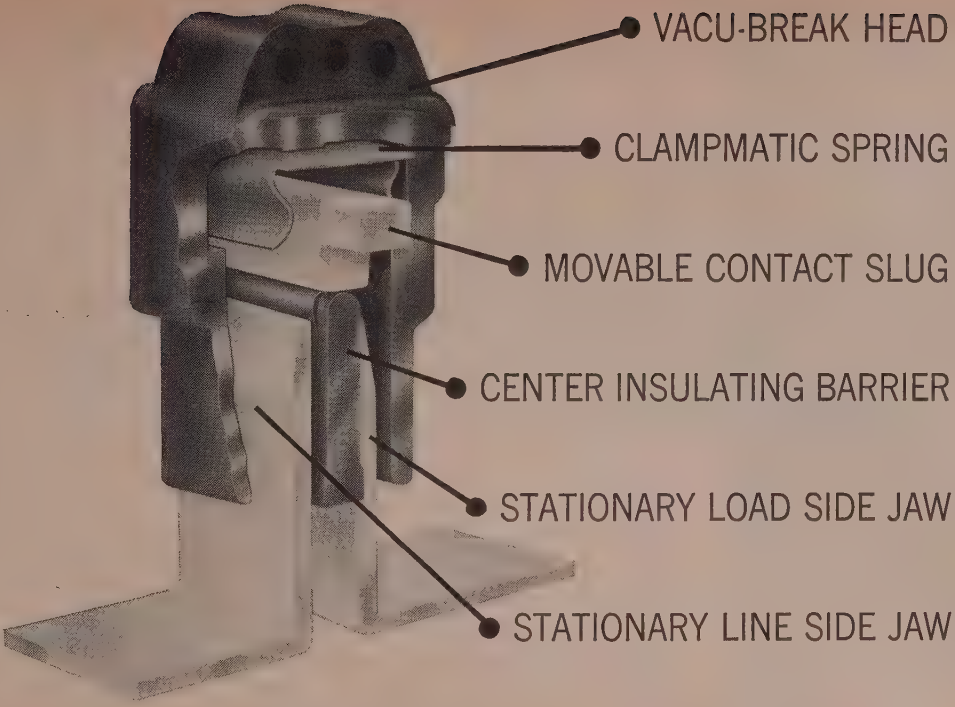
(77) FLUORESCENT BALLASTS. Bulletin SOL-9-610, 12-page Ballast Buyers Guide, permits quick selection of proper ballast for a wide range of lamps. Sola Electric Co.

(78) VOLTAGE REGULATOR. Bulletin 21B7977E describes JFR distribution regulator, covering new features and advantages. Allis-Chalmers Mfg. Co.

(79) ELECTRIC HEATER. New floor furnace designed especially for mobile homes and small homes is described in new brochure. Ramco Mfg. and Engineering.

(80) STRUCTURAL SUPPORT materials, including Kindorf channel, fittings, hangers and concrete inserts are detailed in new indexed catalog-handbook. Steel City Electric Co.

(81) STEEL CONDUIT. Information on applications in electrical construction together with applicable provisions of the 1959 National Electrical Code are included in "Rigid Steel Conduit and Steel Electrical Metallic Tubing, A Practical Handbook." National Electrical Manufacturers Assn.



INCREASE SAFETY SWITCH LIFE WITH CLAMPED PRESSURE CONTACT AND VACU-BREAK ARC CONTROL

Your customers get longer switch life from BullDog safety witches, thanks to unique BullDog design. The high-tension Clampmatic® spring puts pressure where it belongs—on contact aces after the switch is "ON." Clamped pressure action assures good electrical contact for the life of the switch. It means the witch lasts longer, too, for there's no overheating to damage witch components. In switching "OFF," the pressure's removed before the "break" . . . providing true quick-break action.

Vacu-Break® design is another reason BullDog safety switches ast longer. Switching contacts are completely enclosed in the Vacu-Break head. Arcs are restricted, starved of oxygen, cooled nd smothered quickly. In addition, Vacu-Break *double*-breaks he circuit, effectively reducing the arc length and arcing time.

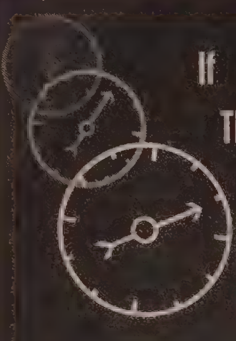
Vacu-Break arc control plus clamped pressure contacts add up o long switch life . . . and dependable, economical service for our customers. You'll find BullDog safety switches need little r no maintenance over years of heavy-duty use. See your BullDog products distributor.

FOR SAFETY'S SAKE—BUY VACU-BREAK!

FROM 30 TO 1200 AMPS.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY
BOX 177 • DETROIT 32, MICHIGAN

Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N.Y.

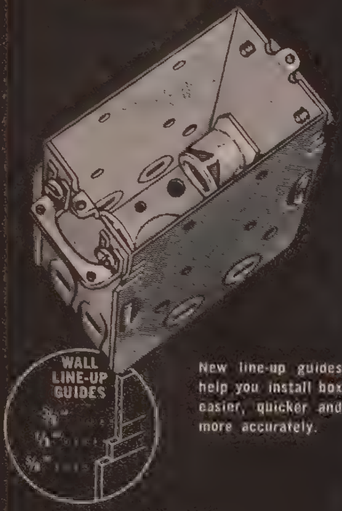

If TIME Figures In Your PROFITS -

Your wisest choice is the . . .

ARROLET

Non-Gangable

SWITCH BOX



New line-up guides help you install box easier, quicker and more accurately.

—*other top features:*

- Slotted cable knock-outs lift out clean and easy.
- Square corners allow more wiring room.
- Available with brackets.

—an excellent box for your next job. Write for specification sheet.

Quality Needed for Tomorrow is in Arrolet Products . . . *Today!*

SWITCH BOXES
OUTLET BOXES
BOX COVERS FITTINGS

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Sales Representatives & Warehouse Stocks* BALTIMORE, MD. • *CHICAGO, ILL. • *CINCINNATI, OHIO • DALLAS, TEX. • GREENSBORO, N. C. • *KANSAS CITY, MO. • *LOS ANGELES, CALIF. • *MIAMI, FLA. • NEW YORK, N. Y. • NEWTON CENTRE, MASS • *PHILADELPHIA, PA. • *RICHMOND, VA. • ROCHESTER, N. Y. • *SEATTLE, WASH. • *TAMPA, FLA.

(82) WIRING DEVICES. Specification list details all wiring devices and fuses complying with Federal and REA specifications, to aid bidders on government contracts and specification writers. Eagle Electric Mfg. Co. Inc.

(83) LOW-VOLTAGE WIRING. Illustrated brochure covers applications of Remcon low-voltage switches and relays through the experiences of two cartoon characters. Pyramid Instrument Corp.

(84) POWER UNITS. Rectifier type units for producing dc from existing ac power lines are described in Bulletin 118A. Opad Electric Co.

(85) ALUMINUM CONDUCTORS for overhead transmission lines. 90-page booklet, "Resistance and Reactance of Aluminum Conductors," gives results of recent research programs. Aluminum Co. of America.

(86) DEAD-ENDS for pole lines. 32-page "The Good Guy," describing controlled slip technique of equalizing multiple guy tensions, and 24-page pocket-size lineman's field booklet are available. Preformed Line Products Co.

(87) LIGHTING FIXTURES. 4-page catalog describes new Galaxy, Mardi Gras, and Astral collections with data on dimensions and wattage. Progress Mfg. Co., Inc.

(88) SNAP-ON VOLTMETER. Catalog A603, 4 pages, illustrates all models of Amprobe volt-ammeter-ohmmeter, with complete specifications and applications. Pyramid Instrument Corp.

(89) DISTRIBUTION EQUIPMENT. New 300-page Easy Estimator gives current prices of complete line. Continental Electric Equipment Co.

(90) FLEXICORE RACEWAY. 8-page manual, "How to Make Openings in Flexicore Decks," covers use of power and star drills for making access holes from one to six inches in diameter. Flexicore Co., Inc.

(91) CIRCUIT BREAKER. Bulletin GEA-7070 gives complete selection and application information on new molded case circuit breakers. General Electric Co.

(92) THERMAL INSULATION for homes. 24-page booklet describes all types of insulation and their application for electrically heated homes. Owens-Corning Fiberglas Corp.

(93) DIMMER SWITCH. 4-page bulletin describes new dimming control using an electronic circuit which may be installed in place of existing wall switch to provide two lighting levels. Slater Electronics Corp.

(94) SOLENOID BRAKES. Bulletin EE-220, 16 pages, describes five new lines varying from a 2½-in. to a 14-in. wheel, including explosion-proof models. Trombetta Solenoid Corp.

(95) CIRCUIT BREAKERS. Bulletin 5001-1A, 40 pages, describes complete line of molded case breakers with information on ratings, overcurrent devices and accessories. I-T-E Circuit Breaker Co.

(96) PROTECTION HANDBOOK. New edition contains helpful suggestions for selecting proper protective devices for electric circuits and other equipment. Bussmann Mfg. Div., McGraw-Edison Co.

(97) SWITCHES & RELAYS. New 4-page brochure covers miniature, subminiature, open blade, general purpose, metalclad, and machine tool switches and several types of relays. Acro Div., Robertshaw-Fulton Controls Co.

(98) CONTROLS. Catalog GEC-1260D, 72 pages, contains information on complete line of control devices, including motor starters, contactors, relays, solenoids, limit switches, pushbuttons and static devices. General Electric Co.

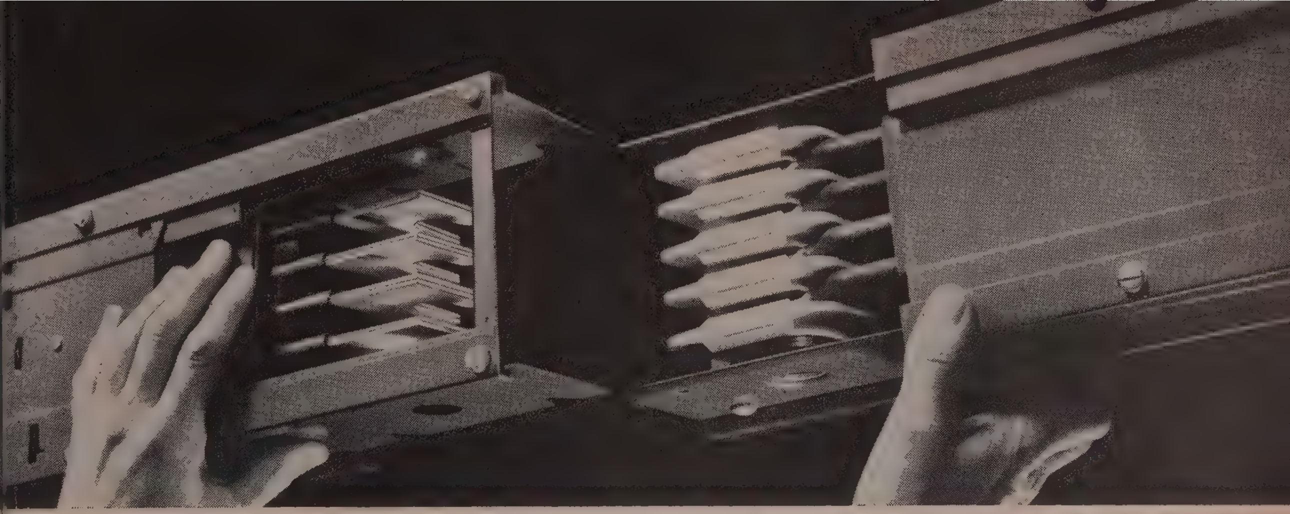
(99) BUS DUCT for high-frequency applications. Booklet B-7326-380 outlines features and contains voltage-drop curve at 400 cps plotted against load. Westinghouse Electric Corp.

(100) CHARGERS for stationary-type batteries. Technical data aids in selecting and using constant-voltage, silicon-rectifier chargers. Exide Industrial Div., Electric Storage Battery Co.

(101) VOLTAGE REGULATORS. Application Bulletin AC610 gives information on how to use single-phase ac line-voltage regulators to accomplish effective regulation in three-phase circuits. Sorenson & Co.

(102) CIRCUIT BREAKERS. 20-page Bulletin GEA-5915E shows specifications and operating features of complete line of low-voltage stored-energy power circuit breakers.

(103) HEATING ELEMENTS, including cartridge, tubular, immersion, strip, band, and air duct type; fuel-oil heaters, circulation heaters, and soldering equipment. Bulletin VG-100. Vulcan Electric Co.



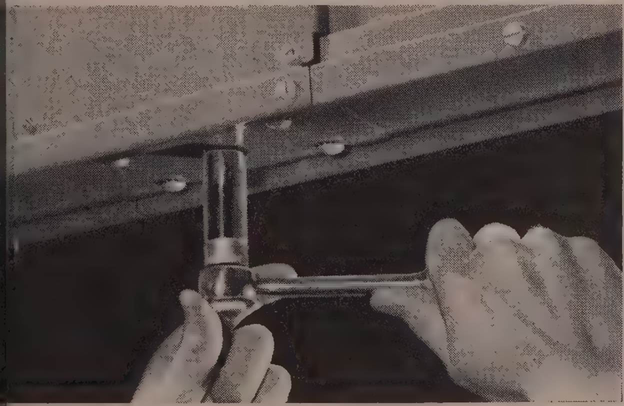
NEW BULLDOG XL BUSTRIBUTION DUCT

CUTS INSTALLATION TIME 3 WAYS

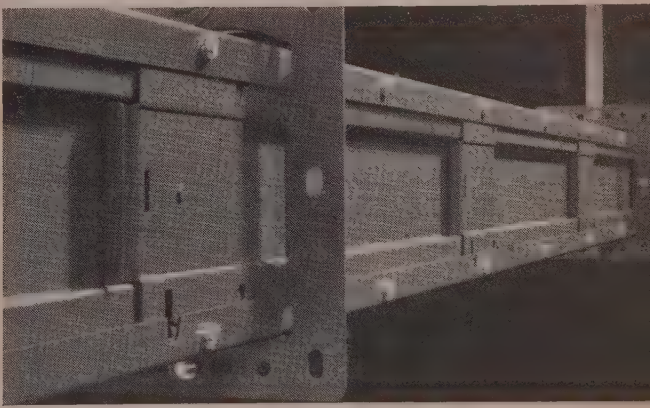
You can install XL BUStribution® Duct easier, faster than any other duct because of these exclusive new design features . . . plated aluminum bus bars with KEYED ENDS slip together fast, align automatically for proper position. There's no fumbling and fitting . . . ONE INTEGRAL BOLT tightens fast, locks joint positively under a ton of pressure. Bolt tightens against bus bar, not against the casing . . . TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

New XL BUStribution Duct is 3 ways safer, too. It's the only true dead-front duct, the only one with exclusive Safety Door, the only one with Safety Plug. And it reduces duct weight on building structure as much as 40%. Ask your BullDog distributor to arrange for a demonstration . . . you'll see how fast to install and how safe new XL BUStribution Duct really is.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N. Y.



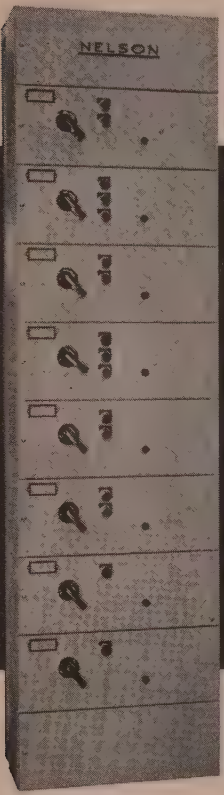
SINGLE INTEGRAL BOLT puts a ton of pressure on keyed bus ends. Joints lock tight *fast*, stay locked.



TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

KEEP PACE ELECTRICALLY



NEED MOTOR CONTROL CENTERS

QUICK?

ORDER NELSON

Quick-trol

and get delivery in

1/2

the usual time

Find Your Nearest
NELSON Representative
in the
'Yellow Pages'

See
"ELECTRIC
EQUIPMENT
MANUFACTURERS"

QUICK SHIPMENTS

Nelson cuts delivery time 50%. Units assembled from off-the-shelf assemblies.

MANY COMPONENTS

Quick-trol units are available with comb. starters, switch or CB type, sizes 1-4 FVNR, sizes 1-3 reversing; Main or branch circ. breakers or fused switches; Lighting panels up to 24 circuits.

SAVES TIME

Quick and *easy* installation due to
- Big 35 sq. in. vertical wiring gutters
- Front access continuous horizontal wiring gutter
- Easy access to main lugs

QUALITY FEATURES

- Attractive, ruggedly constructed cubicles
- Main bus at center for less current density in vertical bus
- Rigid 25,000 AIC bus bracing
- Reliable components throughout

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

(104) MULTI-OUTLET SYSTEM, Plugmold 2200, is described in 4-page folder which gives engineering information on devices and fittings, methods of fastening, and installation. Wiremold Co.

(105) PROCESS TIMERS for controlling repeating cycles. Bulletin GEZ-2985, 4 pages, describes adjustable "on" time units. General Electric Co.

(106) LIGHTING UNITS. New folder, 4 pages, gives condensed information on fluorescent commercial and industrial fixtures, recessed troffers and ceiling systems. Smithcraft Lighting.

(107) RECESSED LIGHTING fixtures, prewired, for use in concrete pour construction. Catalog CP-1 describes fixtures and contains specification charts as well as housing-plan views. Prescolite Mfg. Corp.

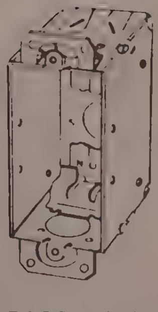
New Books and Pamphlets

Primer of Lamps and Lighting, by Willard Allphin; 224 pages, $10.00. Chilton Co., Book Div., 56th and Chestnut Sts., Philadelphia 39, Pa.

A practical treatment of all types of lamps for commercial, residential and industrial applications for lighting salesmen, electrical contractors, foremen, architects, maintenance superintendents, and students. Illustrated with photographs, charts and graphs, the book describes lamp operation in detail, covers methods of determining lighting levels and number of required fixtures, and includes a slide rule for making lighting calculations.

Elevators: Electric and Electro-Hydraulic Elevators, Escalators, Moving Sidewalks and Ramps, by Fred A. Annett; Third Edition, 400 pages, $11.50. McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y.

A comprehensive and practical treatment of vertical-transportation equipment as used in office buildings, hotels, apartment houses, private homes, department stores, railway stations, garages, industrial plants, and other buildings. This book, revised and updated to comply with the 1955 American Standard Code for Elevators, Dumbwaiters and Escalators, provides a useful and authoritative source of information for electrical workers and mechanics, elevator maintenance men and operating engineers, and others doing elevator repair work.



RACO switch and outlet boxes also available with "Q" Quick-Clamps.

New RACO "Q"* Quick-Clamp now available in Beveled Corner boxes

RACO's revolutionary new "Q" Quick-Clamp that lets you install non-metallic sheathed cable in seconds . . . with no screws to tighten . . . is now available in complete line of RACO beveled corner boxes, too!

The new "Q*"$_B$ Quick-Clamp for beveled corner boxes has the same time and money saving advantages as the original "Q" Quick-Clamp introduced last year:

1. Simply push cable into "Q" Quick-Clamp . . . no screws to tighten . . . no threads to strip.
2. Pull cable into clamp to any length desired.
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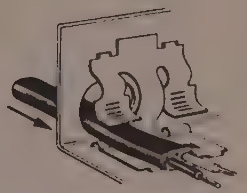
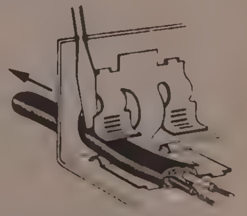
The new "Q" Quick-Clamp grips cable tightly . . . it can't be pulled out . . . exceeds Underwriter Laboratories' tests (fully protected by patents). Get the new "Q" Quick-Clamp switch and outlet boxes now at your RACO Distributor.

*T.M.



Cable moves freely into clamp and is tightly gripped.



To back-off cable, release clamp pressure with screwdriver.

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Electrical Engineering for Professional Engineers' Examinations, by John D. Constance; 456 pages, $9.50. McGraw-Hill Publishing Co., 327 W. 41st St., New York 36, N. Y.

This book offers candidates for Professional Engineer's license the materials they need to prepare for the electrical engineering examination, providing a quick run-through of electrical theory and methods of application, and scores of questions which are typical of those asked at the examination. Each question is followed by the type of answer expected by the boards of examiners in the various states.

Light Bulbs and Fluorescent Tubes for the Home, 15 pages; $3.00 per 100 copies. Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.

A handy reference guide dealing solely with light sources used in the home. This booklet covers such items as bulb finishes and coatings, applications for tinted light bulbs, uses for silvered bowl lamps. Drawings illustrate variety of bases, sizes and shapes; the problem of lamp life in terms of household economics is treated in detail.

NEMA Standards. New publications available from National Electrical Manufacturers Assn., 155 East 44th St., New York 17, N. Y.:

LG 3-1959: *Installation of Vertical Hydraulic-turbine-driven Generators;* $2.00.
SG 5-1959: *Power Switchgear Assemblies;* $4.00.
WD 2-1959: *Wiring Devices;* $0.20.

Resistance and Resistors, by Charles L. Wellard; 272 pages, $8.50. McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y.

New reference and guidebook presents groundwork in basic aspects of resistance and detailed descriptions of each type of resistor, the materials used in its manufacture, and associated characteristics. Tables, charts and graphs give data on power and voltage ratings and applications. Types covered include wire-wound and non-wire-wound types, hermetically sealed types, thermistors, varistors, potentiometers, audio attenuators, and specialty products. Addition of data of most manufacturers makes this book a valuable reference.

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Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Motor Burnouts

QUESTION H37—Within one year, we have had eight out of 16 motors of our circulating roof fans burn out. Motors are 3 hp, 3-phase, 220 volts. Conductors are No. 10 TW. Location of protection, which is 30-amp fused switch and heater protection, is 75 to 150 ft away. Motor burns out the first time the fuses are blown. Heaters don't kick out. What possibly could be the cause of the excessive number of motor burnouts?—J.J.B.

ANSWER TO H37—Excessive motor burnouts indicate possibly that the motors are overloaded and that the overload protection is either not correctly wired in the circuit, which is doubtful, or has been increased to the point where it cannot protect the motor from burnout. The overloads should be sized 1.25 times the nameplate current or 12 amps, for a 3-phase, 220-volt, 60-cycle, 3-hp motor.

J.J.B. could check his motor voltages at full load at the motor and see that it agrees within 2% of the nameplate rating on the motor. If it does, low-voltage burnouts can be eliminated as the cause.

The next step would be to take an amperage check on the motors. This may tell the story and the fan load may be the cause of the overload. Check the speed of the motor, fan speed, and the fan rating in cubic feet per minute. Calculate the hp of the fan as follows:

Hp = Cubic Ft Air Per Min × Water Gauge Pressure In./6.355 × Eff. of the Fan.

The fan hp required must be less than the motor hp or the motor will be overloaded. Putting in oversized overloads will only cause the motors to burn out as the heat goes up four times for every double in amperage, (I^2R) watts. When the fuses finally blow, the motors are burned out. Fuses only protect against short circuits. The horsepower of a fan varies as the cube of the fan speed and directly as the density of the air.

J.J.B. does not say whether the circulating roof fans are directly driven or driven by belts and sheaves. If they are belt driven, it should be practical and certainly economical to go to a larger driven sheave on the fan shaft.

Assuming the fan and motor were designed for this application, check the temperature rise which should not be over 20°C. or at, for example, 72°F ambient, 140°F total. The hand can be held on the motor if that temperature is maintained. The motors may not be getting proper ventilation. The ceiling may be acting as a heat sink; if that is true, then ventilation must be supplied to the motors. I do not have enough specific information to give J.J.B. any procedure except general checks to locate his trouble. However, he will find his trouble if he will follow through on these general checks.—E.J.M.

ANSWER TO H37—Ventilating fans are subject to being driven in reverse rotation by prevailing winds when the power is turned off. If power is applied to the fan motors when they are being driven in reverse rotation, the current drawn is considerably in excess to that drawn when the motor is started from a standstill. Under these conditions a fuse could blow, the motor continue to run single phase and still not trip out the overload heaters. The reason for the motor to continue to operate single phase and still not trip out the overload protection is that some fans have motors larger than necessary to drive the load. Therefore if the heater is properly sized to protect the motor it could be large enough to allow the motor to operate single phase and not trip out. With one fuse blown and power applied to the motor at standstill the motor could burnout before the overload units would trip out. The nature of the motor burnout should give a clue as to whether it is a single-phase or 3-phase burnout.

Check the running load current of the motor. In the event it is less than the motor nameplate current, install overload heaters for this load which will give better overload protection.—J.H.P.

ANSWER TO H37—Three possible reasons for roof fan motors burning out are: First—Lightning surges may be causing the troubles. J.J.B. should check to see if there is any relation between thundercloud activity and motors burning out. If there is any evidence of lightning damage, a low voltage lightning arrester should be installed at the motor terminal.

Second—many times these roof fan motors are mounted in enclosures, to protect the motor from rain, dust, snow, soot, kitchen grease, chemical fumes, etc. If the enclosure is improperly ventilated, motor burnout can result. The heaters J.J.B. mentioned should be installed close to the motor, so motor and heater work in the same ambient.

Third—The heaters must be oversized or defective if 30-amp fuses will blow before the heaters operate. Why doesn't J.J.B. use 9- or 10-amp Fusetrons on a 3 hp, 220-volt, 3-phase motor, instead of 30-amp fuses?—J.P.L.

Transformer Noise

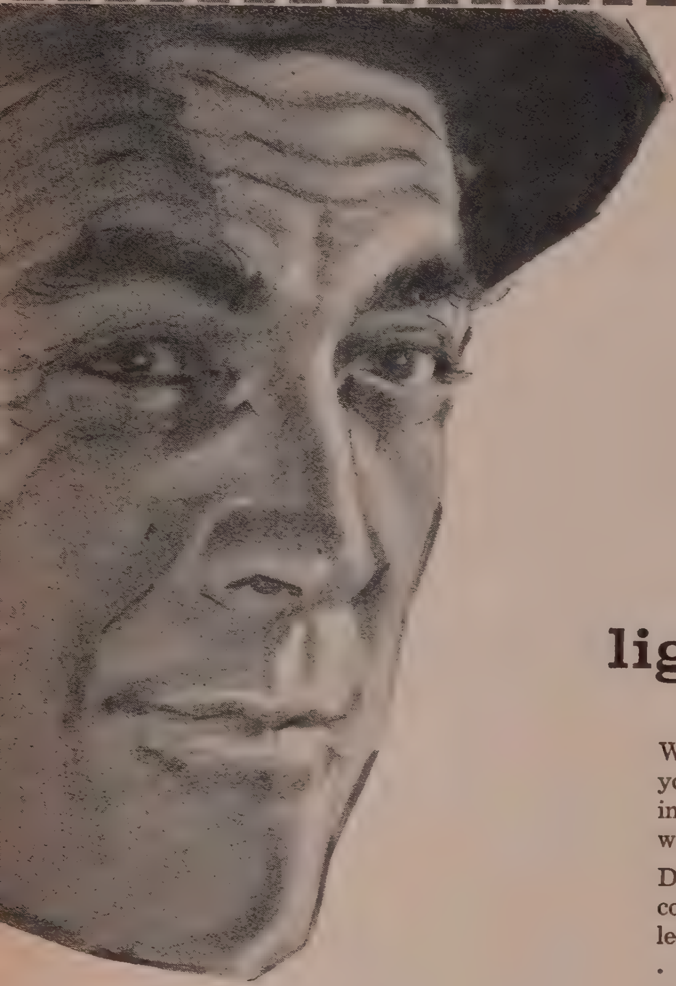
QUESTION J37—We have some 15-kva, 3-phase, 208-volt, 4-wire transformers installed in our office areas supplying lighting and power. These transformers generate a disturbing loud hum, which we would like to reduce to a tolerable level. Can someone suggest the cause of this hum and a practical method for reducing it?—R.E.B.

ANSWER TO J37—There are two types of sound to be considered. The first type is airborne and the second type is conducted sound. With regard to airborne sound a simple screen around the transformer made of some absorbent material such as cardboard or paper board will do an excellent job. This sound enclosure need not close the top of the transformer in as this sort of barrier will absorb the airborne sound very well. Other suitable materials to use are curtains, or the acoustic tile products that are used for ceilings. In the event the transformer is mounted in the air then the acoustic material should be around the transformer but should leave adequate space for ventilation at the bottom and at the top.

With reference to the other type of sound, namely, conducted sound, this is a little more difficult to eliminate. Due to the magnetostrictive effect in steel, the steel laminations of the transformer are actually getting larger and smaller every cycle.

JOB-PROFIT TOOLING IDEAS

FROM GREENLEE



no special attachments needed to bend ALUMINUM CONDUIT with Greenlee lightweight benders

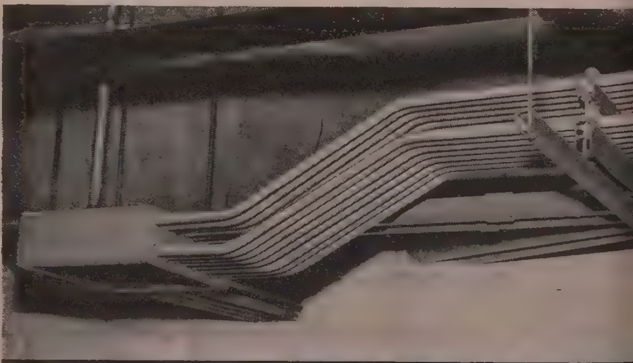
When your jobs call for bending aluminum conduit, you can streamline operations and make big savings in labor and materials with a standard Greenlee lightweight hydraulic bender.

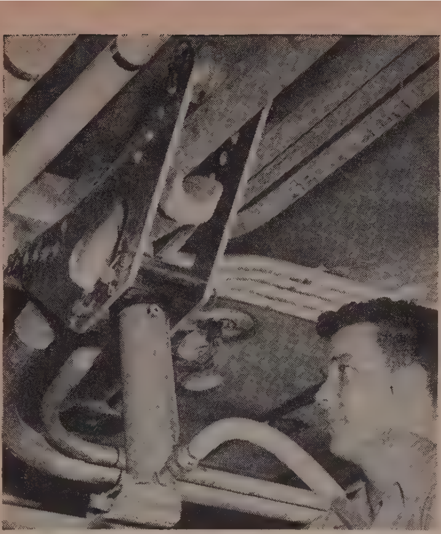
Designed to accommodate *both* steel *and* aluminum conduit and pipe without special attachments, Greenlee lightweight benders are extra rugged, fast, powerful . . . yet one man can easily transport, set up and quickly make uniform bends.

Shown at right are two views of aluminum conduit installations on a large electrical job now in progress. Top illustration shows 16 parallel runs of aluminum conduit with offsets made by a Greenlee No. 888 multipurpose hydraulic bender. Job is typical of accuracy and uniformity of duplicate bends easily made in one shot with Greenlee No. 888 benders.

Lower picture shows complex duplicate offsets and concentric bends at intersection of several conduit runs. All conduit is aluminum and *all* offsets were made with a Greenlee No. 888 multipurpose hydraulic bender . . . other bends were made with a Greenlee No. 884.

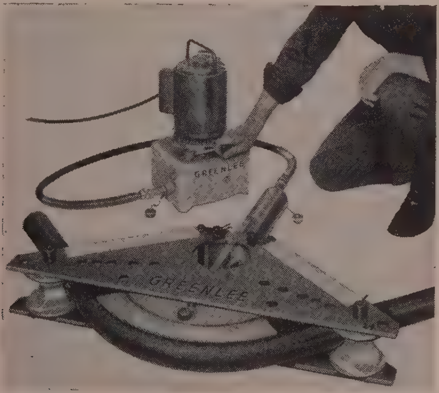
Four Job-Profit Tooling Ideas using Greenlee hydraulic benders are shown on the facing page. High-strength aluminum alloy construction of Greenlee benders holds weight to a minimum for easy portability and one-man operation.



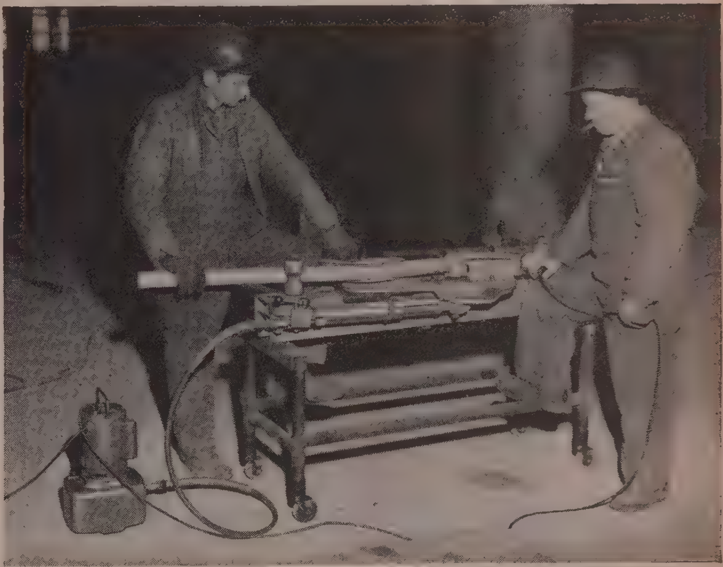


Idea for faster, more efficient bending — Cost for *all* your bending jobs can often be reduced by half or more with a Greenlee No. 880 lightweight hydraulic bender (above) for ½" - 2" aluminum or steel conduit. Available for hand or power pump operation, the No. 880 makes 90° bends in 2" conduit in approximately five minutes with hand pump . . . less than a minute with a Greenlee power pump. Conduit is inserted and removed from the front . . . permits fast "in-place" bending.

Idea for streamlining bending operations on large-diameter conduit—Contractors across the country are finding big aluminum and steel conduit installation jobs are quickly completed with better results, more uniform quality when they put a Greenlee No. 884 lightweight hydraulic bender to work. Forty tons of ram pressure quickly make 90° bends in one shot in conduit ranging from ½" - 4". Operated with standard hand pump or Greenlee power pump.



Idea for controlling costs, making better installations — Actual on-the-job figures show that with a Greenlee No. 883 bender, costs for making bends in aluminum or steel conduit run about one third of that for using manufactured bends and fittings. Complete portability of this lightweight unit makes transportation fast and easy. The No. 883 accommodates eight sizes of conduit from ½" - 3" . . . requires only one size of pipe supports for complete range. Fast hand or power pump operation, plus mobility make this compact bender one of the most important tool investments you can make today.



Idea for making offsets in seconds, with one setting, one shot— When job requirements call for offset bends, make them on the job — in seconds — with a Greenlee No. 888 multipurpose hydraulic bender. Offsets always correctly aligned — no doglegs! Easily operated by one man, this bender also makes 90° bends close to the end of the pipe in one shot. For ½" - 2" conduit, the No. 888 features hand or power operation . . . heavy-duty casters for easy transportation.

Greenlee Job-Profit Tooling offers a complete line of timesaving tools for electrical construction. Get the complete story on how they can help you to control costs, write for Bulletin E-240 today.

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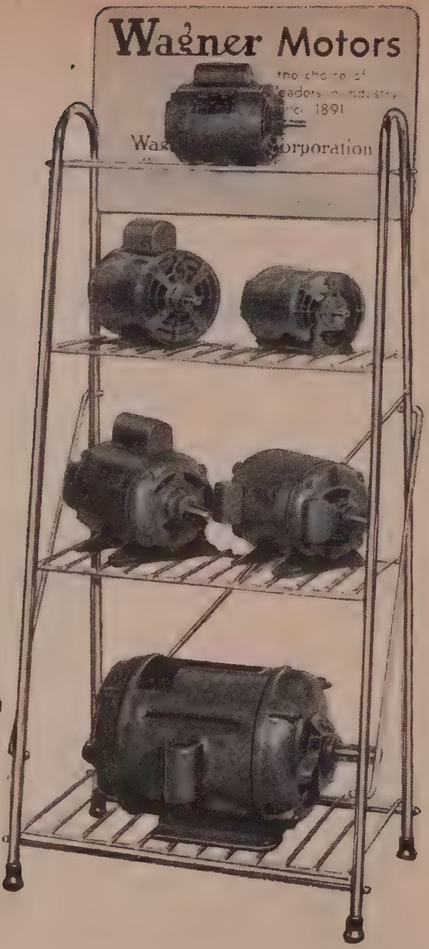
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This mechanical motion of the laminations is transmitted to the framework of the transformer and through the framework to the foundation or structure on which it is mounted. If the transformer is rigidly bolted to the structure, then these mechanical vibrations are passed on to the structure and this motion will be felt even a great distance away. The only way to get rid of this is to interpose between the transformer and the structure itself some form of sound barrier such as rubber or cork and rubber compounds. There are a number of companies who specialize in providing motion absorbers of this nature and I would suggest to the reader that he get in touch with these people to select the appropriate barrier.—H.H.S.

Single Phasing

QUESTION K37—What would be the effects of a fuse blowing in either of the primaries or secondaries of three transformers connected in star, to a 3-phase motor? —G.J.P.

ANSWER TO K37—Your question has many complications and there is no simple solution to it but the following may be helpful.

First of all, a blown fuse causes single phasing, but once a 3-phase motor is started it will continue to run and will also generate 3-phase power. Now, if there is one large lightly loaded motor in the system, it will carry the smaller ones with no adverse effect upon the system. The complications are contingent upon many factors, i.e., transformer kva capacity, total connected motor load, loading upon each individual motor. But under normal, balanced conditions, 3-phase motors fed by single phase power will draw overload current and will be removed from the line as the starter overload will trip under these conditions.—J.A.M.

Editor's Note: If the transformers in question are connected wye-wye, high currents will appear in two phases and a low current in the other when a fuse opens. Because of the increased current in the two phases, a 3-phase starter with two properly sized running overcurrent devices will drop the motor off the line.

On the other hand if the transformers are connected delta-wye, only one phase may carry a high current to the motor when a fuse opens. This would depend on whether the fuse that opens is the

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branch circuit, feeder, or service equipment fuse. If it is a branch circuit fuse to the motor that opens, and the motor is fully loaded, the motor could burn out if the phase having a high current is the phase having no running overcurrent protective device. Three motor running overcurrent devices, instead of two, will prevent this possibility. Three-pole, common-trip, branch circuit breakers are an alternate solution.

If primary single phasing is prevalent on the serving utility's supply, and the transformers are connected wye-delta or delta-wye, three motor running overcurrent devices should be provided for each motor to avoid burnouts.—J.H.W.

Can You Answer These QUESTIONS?

QUESTION T37—I would like to know if any reader has had experience with a crane for loading scrap iron with an electromagnet. The magnet does not release the material fast enough and there is a considerable arc from the contacts. Would this be caused by the field discharge resistor failing to operate? I would like to see a wiring diagram of the entire electrical system including the starter itself. This crane is driven by a gasoline engine.—E.T.

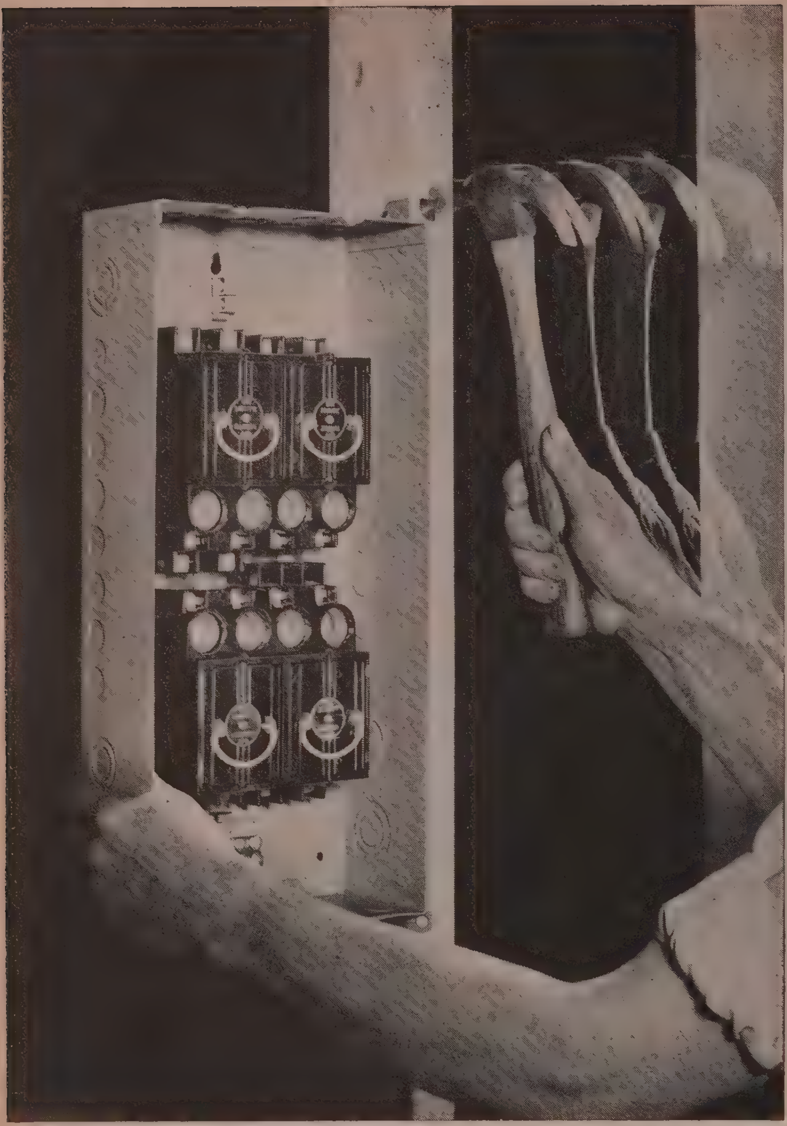
QUESTION U37 — We are in the throes of changing our control circuit voltage from 440 to 110. This will be accomplished by the use of single-phase transformers.

Our power distribution system consists of both the star (grounded 4-wire) and delta (ungrounded 3-wire) in separate areas, of course. The question is whether to ground the secondary side (110 volts) of the control circuit transformer. Further, will there be any undesirable effects of either method on either system and finally, which is preferred?—J.A.M.

QUESTION V37—Can anybody tell us how to build a bake and burnout oven large enough to take a 100-hp motor? We have 220-volt, 3-phase power available.—O.H.

QUESTION W37 — Is there any practical method of raising the frequency by means of electronic tubes for power purposes?—E.B.

PLEASE SEND IN YOUR ANSWERS BY APRIL 15



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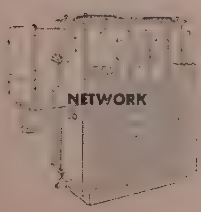

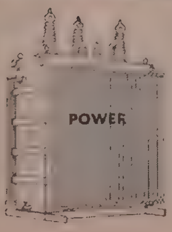

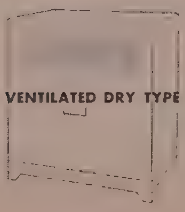

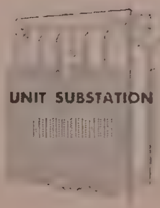

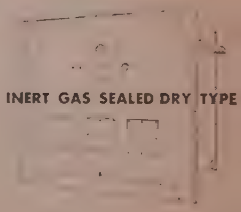
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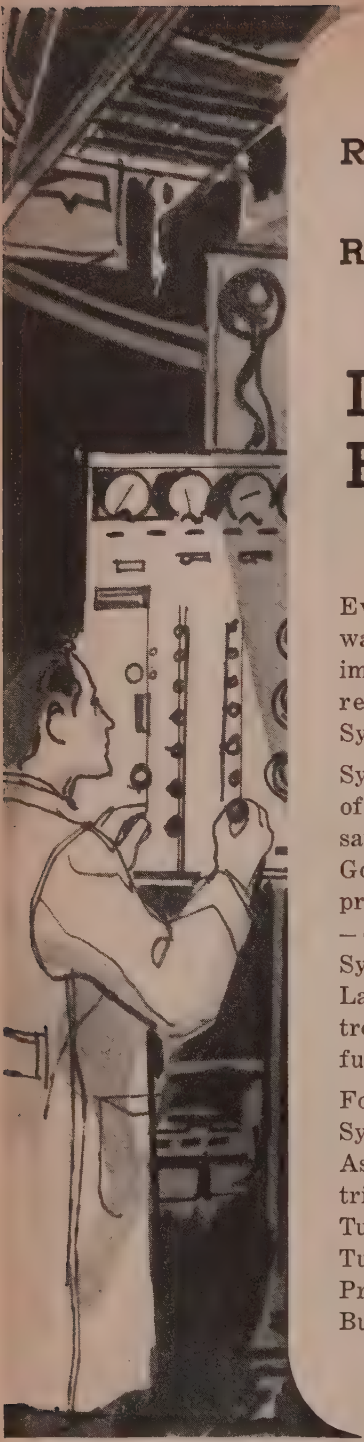

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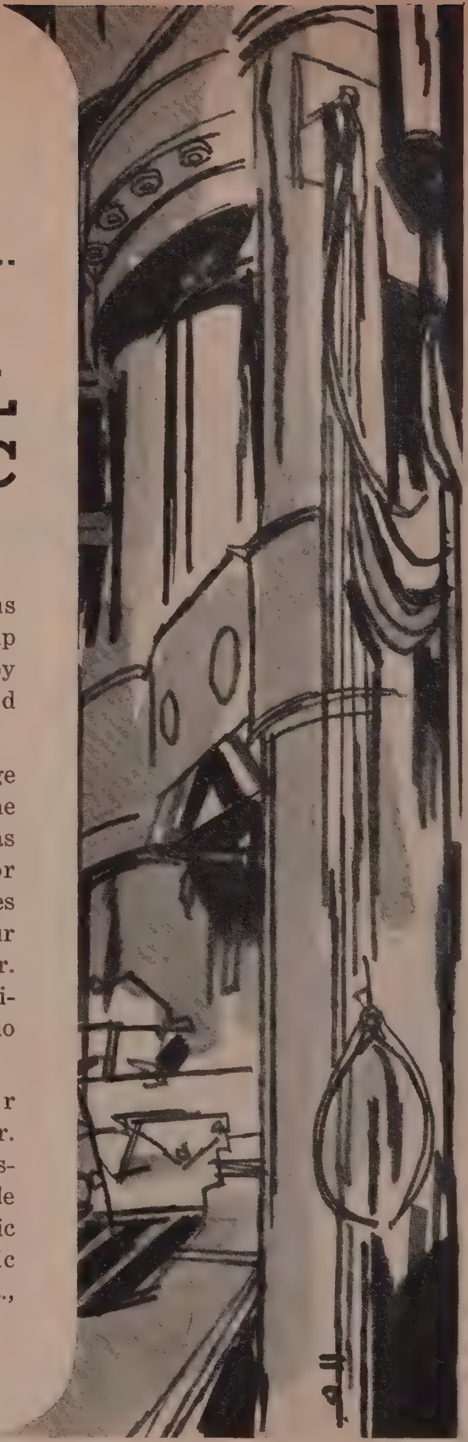


Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Pull Box Computations

Q. *Below is a sketch of a pull box. My co-workers are of the opinion that this pull box is unacceptable under the National Electrical Code. I disagree with them and the reasons have been noted on the sketch.*

I would greatly appreciate your opinion on this subject.—F.S.

A. For the convenience of our readers, the provisions of Section 336-10 of the code read as follows:

"Bends. Bends in cable shall be so made, and other handling shall be such, that the protective coverings of the cable will not be injured, and no bend shall have a radius less than five times the diameter of the cable."

This rule applies to non-metallic sheathed cable, which in itself is a wiring method covered by Article 336. According to the provisions of Section 336-2 this type of cable is limited to sizes No. 14 to 4 AWG inclusive. It therefore appears that this rule does not apply to the 500 MCM conductors shown on your diagram, and it also appears evident that the size of a pull box is based on the size and the number of raceways entering and leaving the box.

Section 370-18-a2 reads as follows:

"Angle or U Pulls. Where angle or U pulls are made, the distance between each raceway entry inside the box and the opposite wall of the box shall not be less than six times the trade diameter of the raceway. This distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries on the same wall of the box. The distance between raceway entries enclosing the same conductor shall not be less than six times the trade diameter of the larger raceway."

According to your illustration, shown by Fig. 1, we have two-3½-in. conduits entering one wall of the box. One is a spare conduit for future use. The 500 MCM cable enters the box through one of these conduits and leaves the box at an angle as shown in Fig. 1. In order to more clearly visualize the situation, I have shown the third dimension in Fig. 2. Applying the above quoted rule, on the basis of the three conduits which are now connected to the box, the various dimensions are computed as follows;

"A" equals six times 3½ or 21 in.

"B" equals six times 3½ plus 3½ or 24.5 in.

"C" is determined by the size of the locknut and the spacing desired.

Since the spare conduit entering the box anticipates future addition, it is essential that provisions for future use be provided at the time of installation. If an angle turn is anticipated as shown on Fig. 2, the "A" dimension would be increased to 24.5 in. If a straight pull is anticipated, as shown by the conduit with dotted lines, the "B" dimension would be increased to eight times 3½ or 28 in. Unless the location of the box would make it impossible to install a straight pull, I believe that the box should be designed for the maximum condition of use. Applying this logic, the box should have the following dimensions;

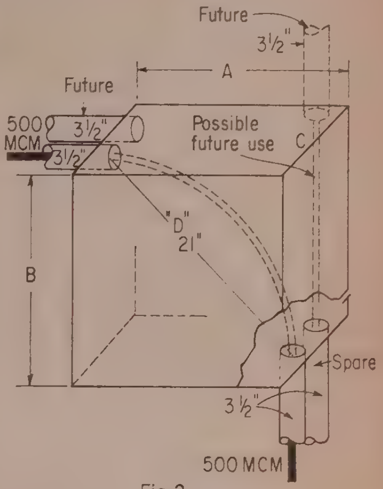


Fig. 2

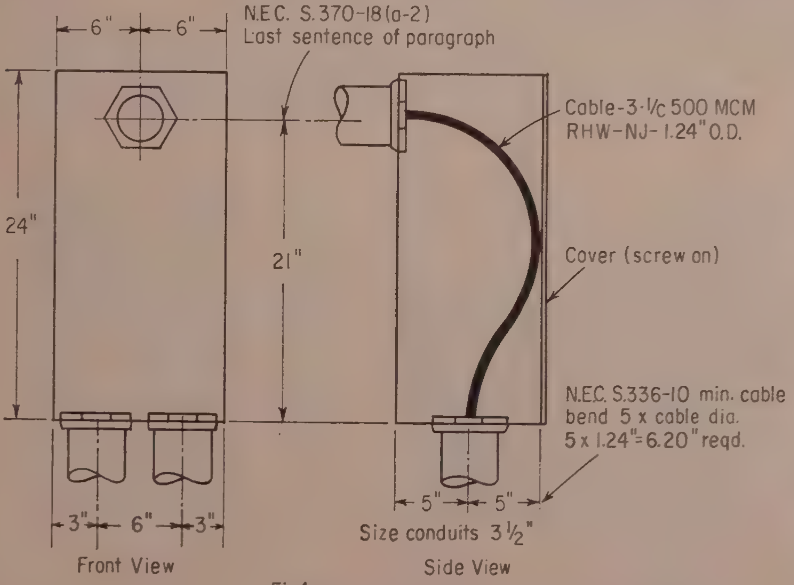

6"
6"
N.E.C. S.370-18(a-2) Last sentence of paragraph
24"
21"
Cable-3-1/c 500 MCM RHW-NJ-1.24" O.D.
Cover (screw on)
N.E.C. S.336-10 min. cable bend 5 x cable dia. 5 x 1.24"=6.20" reqd.
3"
6"
3"
5"
5"
Size conduits 3½"
Front View
Side View

Fig.1

"A" equals six times 3½ plus 3½ or 24.5 in.

"B" equals eight times 3½ or 28 in.

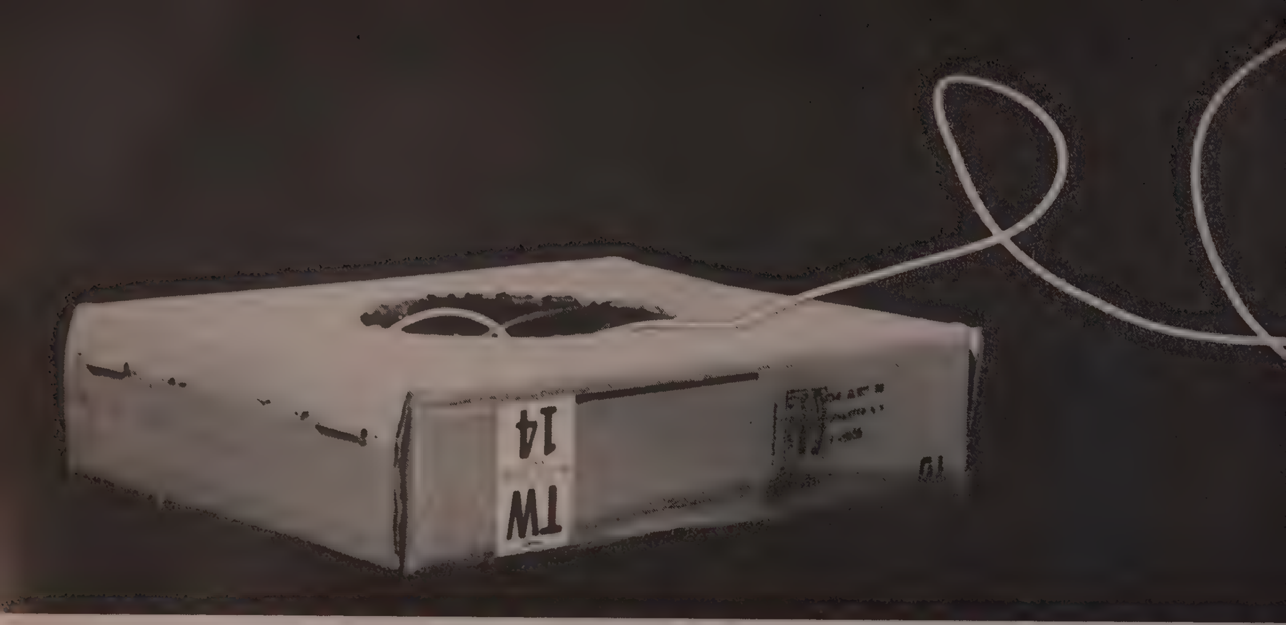
"C" is determined by the size of locknut and spacing.

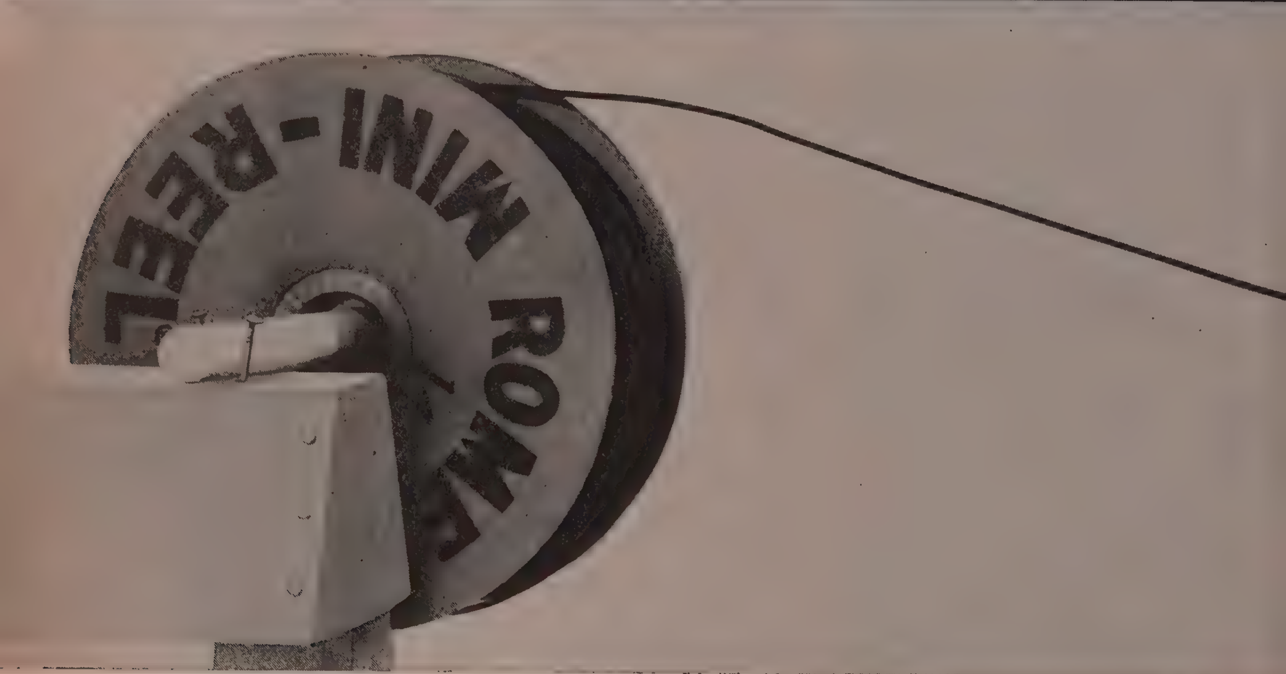
The provisions of the last sentence of Section 370-18-a2 also must be satisfied. As shown on Fig. 2, dimension "D" must be at least six times 3½ or 21 in.

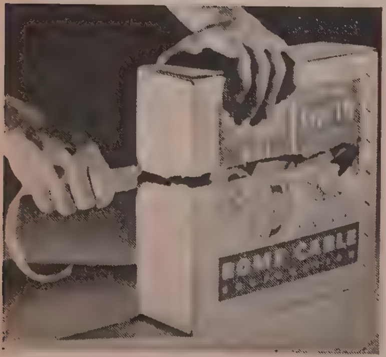
It appears evident from the foregoing, that the box shown in Fig. 1 is considerably smaller than that required by the N. E. Code.—B.A. McD.—3/60/1

Type MI Cable

Q. *Can approval be given an installation where mineral insulated metal sheathed cable, Type*







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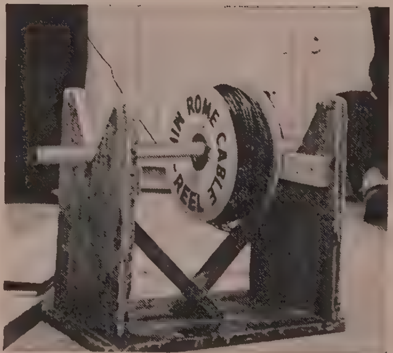

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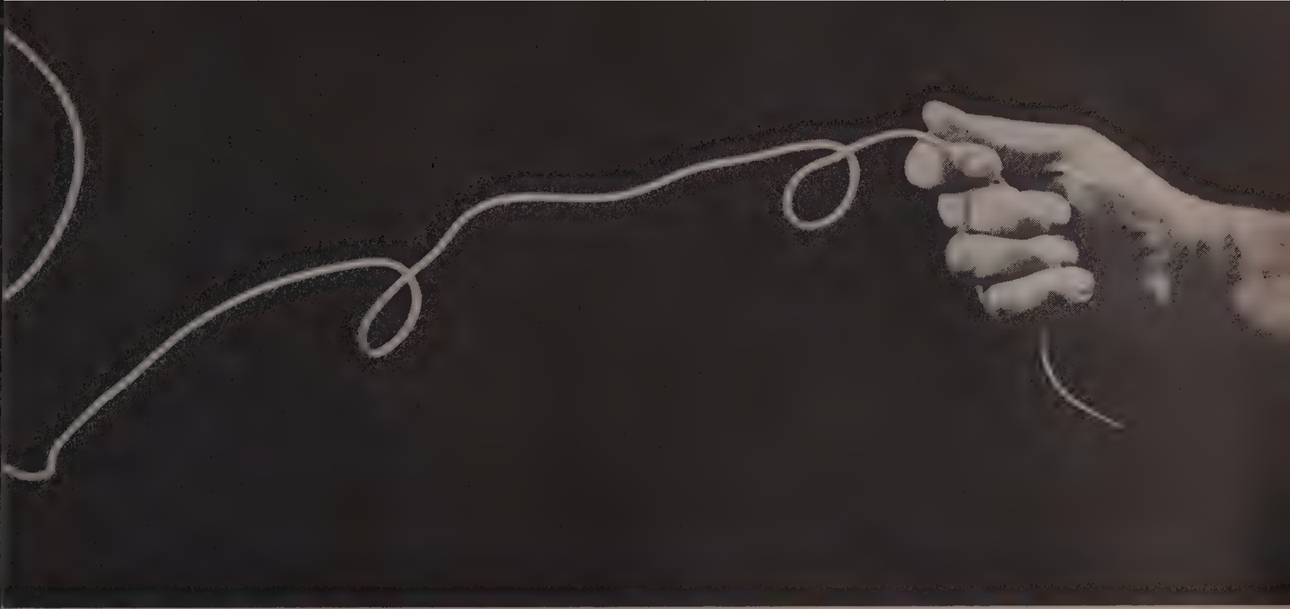

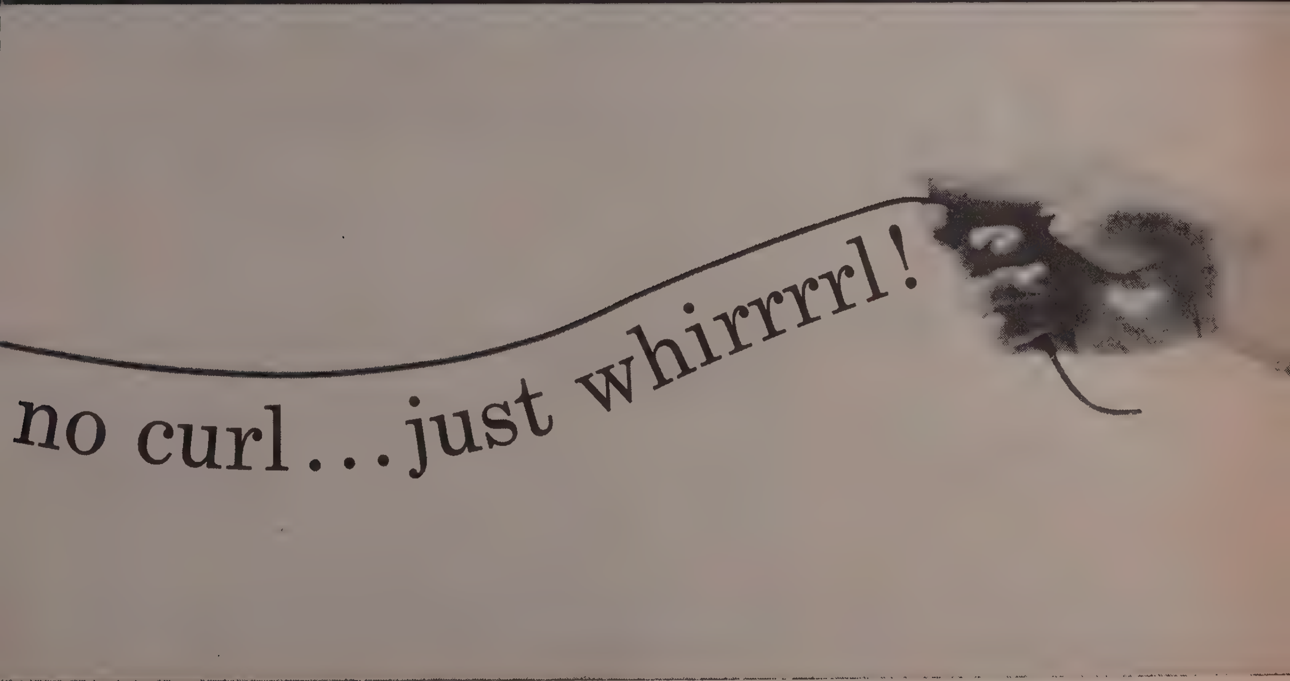

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MI, is used in direct contact with the earth such as underground wiring at a service station?—H.M.B.

A. Yes, with certain precautions. Your question is covered in Article 330, Section 330-2 of the 1959 Code which reads:

"Use. Mineral insulated-metal sheathed cable may be used for services, feeders and branch circuits in both exposed and concealed work, in dry or wet locations; in Class I, Class II and Class III hazardous locations as noted in the appropriate Articles; for under-plaster extensions as provided in Article 344; and embedded in plaster finish on brick or other masonry. It may be used where exposed to weather or continuous moisture, for underground runs and embedded in masonry, concrete or fill, in buildings in course of construction or where exposed to oil, gasoline, or other conditions not having a deteriorating effect on the metal sheath. The sheath of mineral insulated-metal sheathed cable exposed to destructive corrosive conditions, such as some types of cinder fill, shall be protected by materials suitable for those conditions."

You will note in the above that the exception to its use would be in an area where chemical conditions would cause deterioration. You will also note under Section 501-4 that MI cable can be used in both Class I, Division I, and Class I, Division II locations which would include service stations.—R.E.W.—3/60/2

Immersion Heaters

Q. *Plug-in immersion coils is to be put in bath to heat water. What is the code history on this type of device?—F.L.A.*

A. The Underwriters' Laboratories, Inc., lists such devices for water heaters and also for use with liquids other than water. Whether or not the list includes the type described in this question, I would not know off hand. However, the answer to this particular problem would be found in the particular device that is proposed for use. If an examination of this unit shows from its maker's name and model number that it is listed by UL, then we at least know it is an acceptable device. We may, however, have to determine further whether or not such an acceptable device was originally submitted to UL for use as contemplated by this question. If the listing does not specifically designate such use, I would then advise writing to UL to determine whether or not their standards covered such usage.—B.Z.S.—3/60/3

Busway Motor Disconnect Switches

Q. *We have several horsepower-rated cover-operated fusible plug-in switches, which we intend to attach to existing plug-in busway, for use as motor branch circuit overcurrent protection and disconnecting means. The existing busway runs horizontally about 10 ft above the floor.*

We are concerned about Section 4411 (430-107) which states that the disconnecting means shall be readily accessible.

Under what condition can a busway plug-in fusible switch be used as a motor circuit disconnecting means?—E.D.M.

A The provisions of Section 4411 (430-107) which concern the disconnecting means for motors and controllers, read as follows:

"4411 Readily Accessible. The disconnecting means shall be readily accessible."

Readily Accessible is defined by the Code as follows:

"Capable of being reached quickly, for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs etc. (See 'Accessible.')

"Accessible: (As applied to equipment.) Admitting close approach because not guarded by locked doors, elevation or other effective means. (See 'Readily Accessible.')"

Since the definition of "readily accessible" does not specifically refer to elevation, one might infer that a motor disconnect switch could be connected to a busway located ten or more feet above the floor, provided portable hook sticks were available for operating the switch. Such procedure has, in the past, been recognized by some inspection authorities on the basis that the "hook stick" made the switch accessible.

Reference to the 1940 Code indicates that there was no provision, such as now exists under Section 4411 (430-107), which required a motor disconnect switch to be readily accessible. There was however a general provision under Section 3808 which required switches and circuit breakers to be accessible, so far as possible. The present provisions of Section 3808 (380-8) require switches and circuit breakers to be (readily accessible) so far as practical.

On the basis of the 1940 Code, Official Interpretation No. 236 was issued on November 30, 1942. It reads as follows:

"Question: Does the use of a portable hook stick eliminate the question of elevation, as contained in definition of word 'accessible'?"

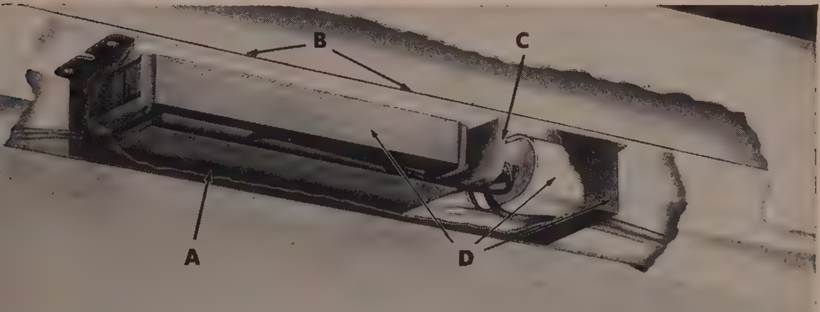
"Question: Does the use of a portable hook stick satisfy the requirements of the definition of the words 'readily accessible'?"

"Finding: The use of switch hooks was not considered in drafting these definitions."

The above finding indicates that the status of a hook stick with respect to the definitions was not definitely established at that time. Since the finding did not specifically state that the use of a hook stick would not satisfy the definitions of "accessible" or "readily accessible," several inspection authorities, who have the responsibility for interpreting code rules, recognized the connection of motor disconnect switches to a busway located ten or more feet above the floor, provided portable hook sticks were available for operating such switches.

According to the provisions of Section 4409 (430-102), "the disconnecting means shall be located in sight from the controller location or be arranged to be locked in the open position." According to this rule one may infer that the disconnecting means could be located in the basement of a building, with the motor and controller on the roof of the building, provided that the disconnecting switch may be locked in the open position. This rule appears to conflict with the provisions of Section 4411 (430-107) which requires the disconnect to be readily accessible, since the definition of this term requires the disconnecting means to be so located that it may be reached quickly for operation. Could a switch, located in the basement of a 5-story building and serving a motor located on the roof of a building, be reached quickly for operation? I don't believe so, but it appears that the code recognizes such an installation. When we consider the latitude provided by section 4409 (430-102), a busway switch, operable

New, cool Sola ballast for two 1500ma lamps gives full light output, features upside-down case



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Comparative Test Results

Ballast	Temperatures ° C		
	Case	Capacitor	Copper
Sola 670-130	80	60	87
Ballast X	81	70	92
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Ballasts tested in industrial fixture suspended one foot beneath ceiling while operating two, 8-foot 1500ma lamps. Ambient room temperature 25° C.

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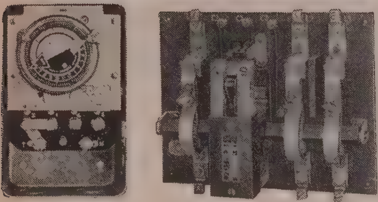

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by a hook stick affords considerably more protection than that provided when the disconnecting switch is located remote from the controller and motor as described.

In so far as the overcurrent device is concerned, Section 2435 (240-16) of the code makes an exception to the fundamental rule which requires such devices to be readily accessible.

This brief summary of the code rules involved with your question indicates to me that the fusible busway switch as described could serve as the disconnecting means, provided it was accessible through the use of a hook stick, and the general maintenance of the plant would assure that such sticks are always available. It would be helpful and assuring to many of us, if the code clarified this question in more detail.—B.A.McD.—3/60/4

Non-Metallic Cable Protection

Q. *I would like an interpretation of Section* 300-8. *Am interested in boring through* 2 *by* 3 *for non-metallic sheathed cable. If hole is in center of* 2 *by* 3, *do we need a steel plate for protection of the cable?—E.L.D.*

A. The pertinent provisions of Section 300-8(a) read as follows:

"When, in exposed or concealed work—cables are run through bored holes in studs, joists or similar wood members, holes shall be bored at the approximate centers of wood members, or at least 2 in. from the nearest edge."

Paragraph (b) of this section recognizes the use of non-metallic sheathed cable laid in notches in the studding or joists provided it is protected against the driving of nails by having the notch covered with a steel plate at least $\frac{1}{16}$ in. thick.

When paragraph "a" of this rule was developed about 28 years ago, the intent was to safeguard the hazard presented when a nail, driven into a joist or stud, penetrated the cable and caused a short circuit. The above quoted wording of this paragraph indicated a desire to bore a hole in the center of a joist, but when floor joists such as 2 by 8 in size were involved, the hole could be bored at least 2 in. from the nearest edge. The 2-in clearance was considered to be free from nails.

In the case of a 2 by 3 where a hole of ½ in. diameter is bored in the center, the cable is within 1¼ in. of the edge of the stud. This is far from the 2-in. limitation required by the code. Under such conditions, I believe the cable should be protected by a steel plate as covered by paragraph (b).—B.A.McD.—3/60/5

Circuit Conductors Supplying Fixtures

Q. 1. *The National Electrical Code, Tables* 1, 2, 1a *and* 2a *give current carrying ratings of conductors based on room temperature of* 30° *C with correction factors tabulated at the bottom of each table for room temperatures over* 30° *C (Tables* 310-12 *to* 310-15).

2. *The National Electrical Code, Section* 3102, *lists the maximum operating temperatures of specific conductors, the lowest temperature listed being* 60° *C (Table* 310-2*a*).

3. *Underwriters Lab., UL-57, Electric Lighting Fixtures, Par.* 188, *allows a maximum temperature "on the supply conductors within the outlet box" of* 60° *C. It is reasonable to assume, after studying the method of testing the fixtures, that the temperatures of the conductors could exceed* 60° *C.*

4. *It is our interpretation of UL-57 that the outlet box above any lighting fixture is not suitable for extending circuits through the fixture and is intended only for end of run use.*

5. *We believe that it is common practice to extend circuits to several fixtures on the same circuit by utilizing the outlet box above any fixture to extend the circuit to any or all of the other fixtures. Is this permitted by the above mentioned codes?*

6. *If the answer to the question in Par.* 5 *is "yes," would it be permissible to serve several fixtures (whose combined intermittent load is* 20 *amps) with No.* 12, *Type TW conductors assuming a "room temperature" of* 30° *C?*

7. *It appeals to us that UL-57 temperature limit mentioned in Par.* 3 *of this letter should be reduced, probably to* 30° *C.—S.G.F.*

A. For the convenience of our readers, the provisions of UL-57, paragraph 188, reads as follows:

"When operated continuously with the largest lamp or lamps which will be used in normal service, a fixture shall not cause a tem-

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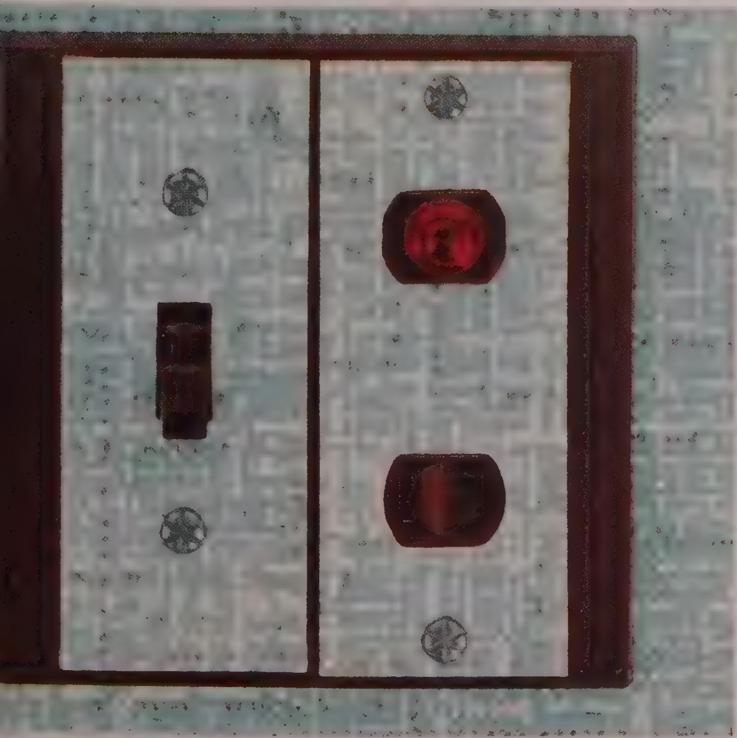

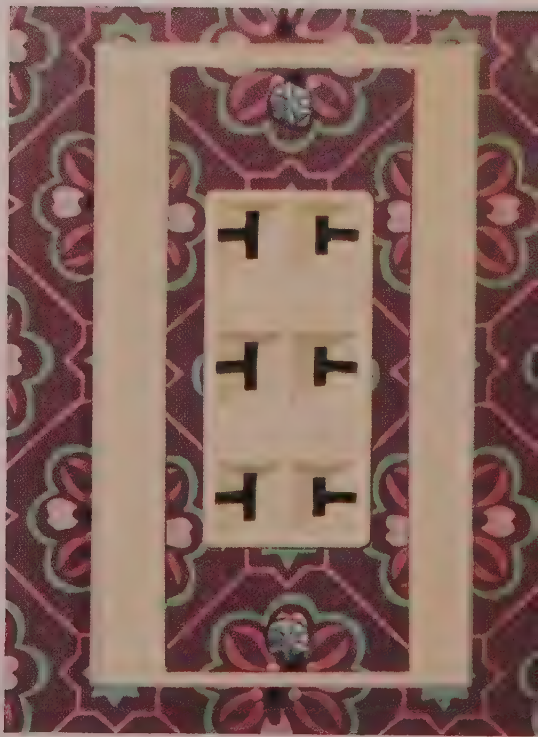

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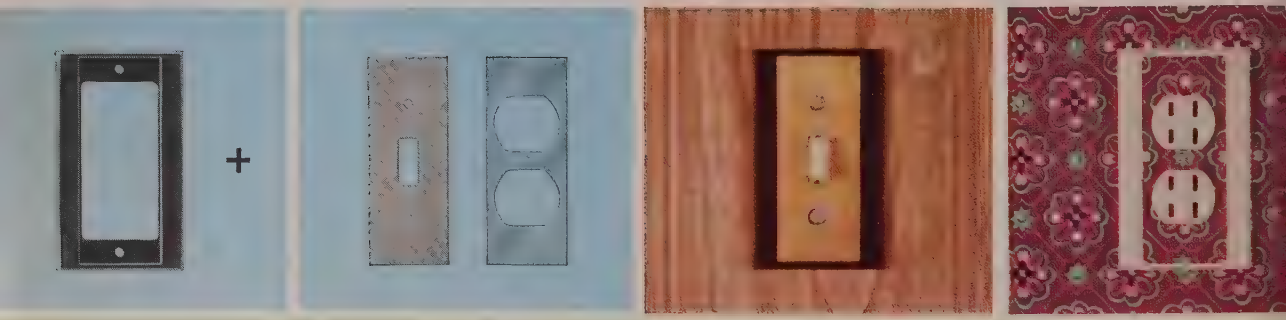

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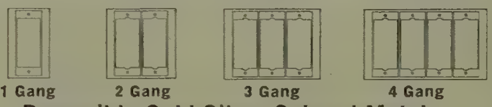

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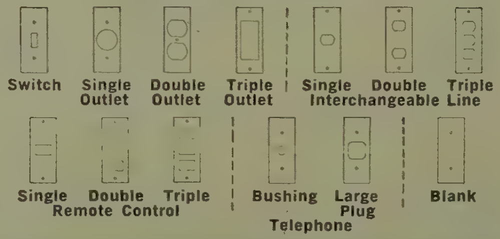

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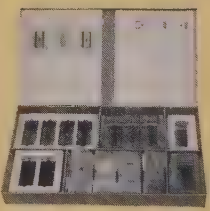

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perature higher than 90 C to be attained on the supporting surface or on parts of the fixture which may be in contact with combustible material, or a temperature higher than 60 C on the supply conductors within the outlet box; except that a temperature higher than 60 C but not higher than 75 C is acceptable if the fixture is marked in accordance with paragraph 308, etc."

Paragraph 308 reads as follows:

"A recessed-type fixture not provided with supply leads as described in paragraph 294 and attaining a temperature higher than 60 C at the point where the supply connections are to be made shall be plainly and permanently marked (see paragraph 230) with the following statement, at or near the point where the supply connections are to be made, and so located that it will be readily visible:

"For Supply Conductors Use Wire"
Suitable for at least —— C

The provisions of paragraph 188 also applies to Electric-Discharge-Lamp Fixtures as covered by paragraph 243. In the case of an Underwriters Laboratories listed recessed fixture, we have specific advice with respect to the type of insulated conductor required. When other types of fixtures are involved, the provisions of paragraph 188 assure us that the fixture design is such that a temperature higher than 60 C will not, in general, prevail in the outlet box. An exception is made where the temperature may be as high as 75 C, but in such cases the fixture will be marked to indicate the type of insulated wire to be used. It is significant to note, however, that the provisions of paragraph 188 only apply when the lamps operate continuously. According to paragraph 190 of UL-57, this condition is satisfied when the fixture under test reaches constant temperature with the size lamps for which it is designed. I am unable to find any tests for fixtures operating intermittently.

In answer to the specific questions raised, the following comment is given:

4. I do not agree that UL-57 prohibits the use of an outlet box serving a fixture to be used for extending the circuit to other outlet boxes, provided the proper type of insulated wire is used, and the conductor is sized properly for the load. According to Section 3102 of the code (Table 310-2 a, 1959 Code) we have several types of insulated conductors suitable for branch circuits which have various maximum operating temperatures. As an example, Type R and T are limited to 60 C; Type RH and RHW are limited to 75 C; Type RHH and AVB are limited to 90 C; Type AVA is limited to 110 C. If I understand your comment correctly, there is no distinction between the use of the conductor for "end of run use" and when used to extend a circuit. In either case they could be subject to the heat of the fixture.

5. It is common practice to extend circuits to several fixtures on the same circuit by utilizing the outlet box above any fixture to extend the circuit to any or all of the other fixtures, provided the type of conductor used has a maximum operating temperature suitable for the fixture temperature. Section 4179 (410-65) of the code, which reads as follows, covers this point:

"Conductors having insulation suitable for the temperature encountered shall be used. Fixtures having branch circuit terminal connections which operate at temperatures higher than 60 C (140 F) shall have circuit conductors as is described, (a) or (b) below:

"a. Branch circuit conductors having an insulation suitable for the temperature encountered may be run directly to the fixture.

"b. Tap connection conductors having an insulation suitable for the temperature encountered shall be run from the fixture terminal connection to an outlet box placed at least 1 ft from the fixture. Such a tap shall extend for at least 4 ft but not more than 6 ft and shall be in a suitable metal raceway."

Section 4150 (410-26) of the code recognizes the use of fixtures as raceways subject to certain limitations. An official interpretation of this code rule appears to give a definite answer to your question. It reads as follows:

"O.I. No. 434. Section 4150. Recessed Fixtures

"Question No. 1—Does Section 4150 apply to recessed incandescent fixtures?

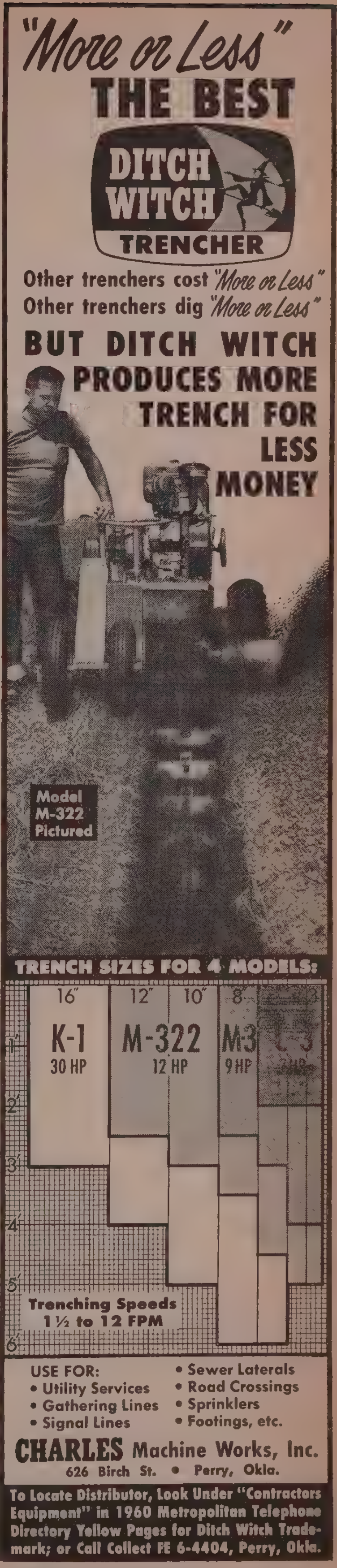
"Answer—Yes.

"Question No. 2—Does Section 4150 apply to recessed fluorescent fixtures?

"Answer—Yes.

"Question No. 3—In the event that the answer to Question No. 1 is 'yes', may recessed incandescent lamp fixtures provided with outlet boxes which have terminal connections operating at temperatures in excess of 60 C be connected by a single circuit which passes through each outlet box of a line of fixtures?

"Answer — Yes, provided the



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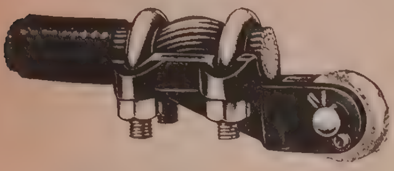

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branch circuit conductors have insulation suitable for the temperatures encountered. See paragraph a of Section 4179."

Paragraphs 309-312 of UL-57 also cover Fixtures Suitable for Use as Raceways, and factors concerning temperature, insulation etc. are also considered.

6. According to the provisions of Section 2127 (210-25) a 20-amp branch circuit, wired with No. 12 TW conductors, may serve a maximum load of 20 amps. Generally speaking, such a lighting load is determined on the basis of watts per square foot as covered by Section 2203-a (220-2a) of the code. This unit load varies with respect to the nature of the occupancy. According to the provisions of Section 2116, (220-2), this unit load must be increased by 25% when the load will continue for long periods of time. The phrase "whose combined intermittent load is 20 amps" indicates to me that the load will not continue for long periods of time such as three hours or more. Under such circumstances, it appears that a No. 12 TW branch circuit could serve a 20-amp load provided the temperature at the fixture would not produce an ambient beyond the temperature limitation of a TW conductor. According to Table 1 of Chapter 10 (Table 310-12), a No. 12 TW conductor has a current-carrying capacity of 20 amps at 30 C, and when it is used in an ambient of 60 C it has no current-carrying capacity. When a fixture listed by UL does not indicate, as covered by UL-308, the type of conductor to be used, a 60 C insulated conductor is considered to be suitable. When the fixture is definitely marked to show the type of insulation to be used, such insulation must be used. It is also significant to note the provisions of UL paragraph 311, which recognizes the use of fixtures as raceways, that the test is made with the branch circuit conductors limited to 80% of capacity. This UL provision coincides with the provisions of Section 2125-b (210-23b) which limit a lighting load to 80% of the circuit when in normal operation the load will continue for long periods of time.

A summary of the foregoing indicates that conditions may prevail where a No. 12 TW conductor, used as a branch circuit serving lighting loaded to its maximum capacity of 20 amps may be used. The many variables, which often lurk obscure in the background, indicates that such procedure is not desirable. A factor of adequacy should be applied in most cases. A circuit operating intermittently today, may be subject to continuous loading in the future. It is considered good practice to anticipate and provide for the future.

7. It would, in my opinion, be impracticable to limit the temperature to 30 C. To do so would eliminate the use of many of our recessed fixture designs which are in use today. Field experience indicates that the present code and UL requirements adequately cover the safety prescribed by the code when properly applied. — B.A.McD. — 3/60/6

Attachment Plug Cap Use

Q. *May a plug be used with either flexible conduit or armored cable for disconnecting purposes for either portable or stationary appliances or motors? Where is this covered in the code, and where does it state that cord would have to be used for such service? Is there any approved plug for flexible conduit or armored cable, or are the uses to which a plug is to be put stipulated in the UL listing requirements?—F.D.*

A. Both flexible metal conduit and armored cable are wiring methods as covered by Article 350 and 334 respectively of the code, and it would be difficult to distort the conditions, under which such wiring methods may be used, to include the scope of cord connections.

Chapter 4 of the code covers equipment for general use, and Article 400 recognizes the use of flexible cords, and one of the principal applications is the connection of portable lamps and appliances. Section 400-4 definitely prohibits the use of flexible cord as a substitute for the fixed wiring of a structure.

Reference to Section 350-1 indicates that flexible conduit is subject to some of the rules which apply to armored cable. As an example, Section 334-5 requires both flexible conduit and armored cable to be supported at intervals not exceeding 4½ ft and within 12 in. from every outlet box and fitting. There is an exception to this provision for lengths not over 24 in. at terminals where flexibility is necessary. While the code does not specifically state that either of these wiring methods shall not be used as cords, with a

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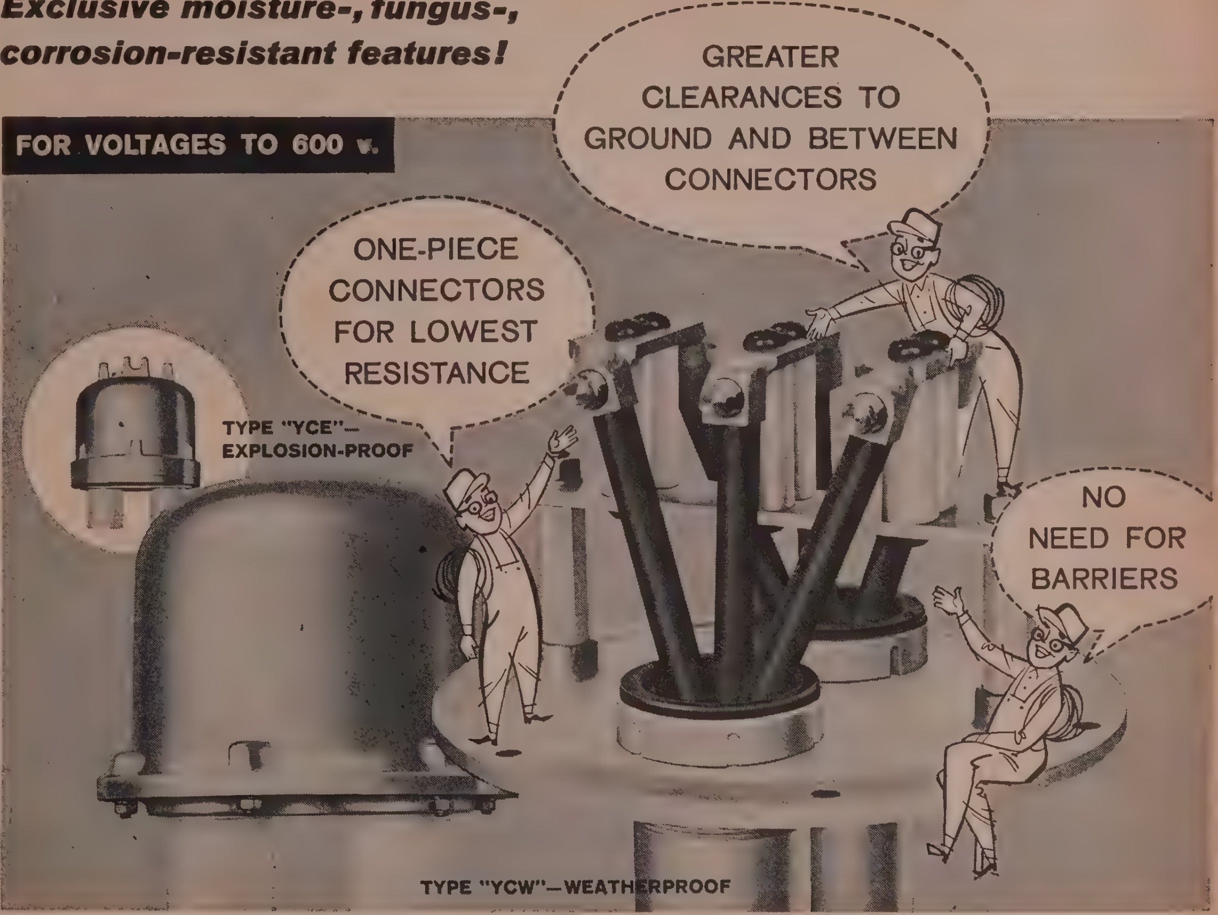
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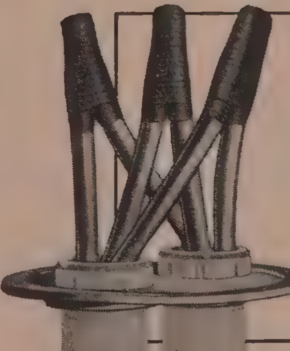

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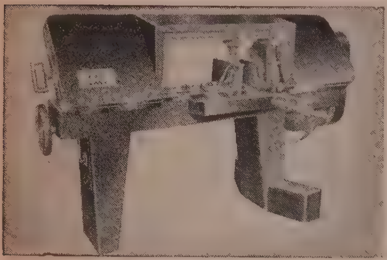

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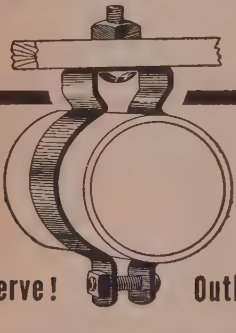

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plug and receptacle connection, it appears obvious that such use never was intended and it could be hazardous. Cords, with their numerous stranded conductors, provide a degree of flexibility which ordinary building wire, either solid or stranded, cannot equal.

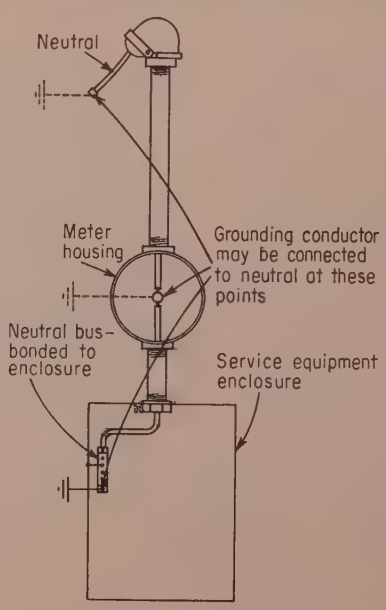
In view of the foregoing, it is my opinion that attachment plug caps are not designed to be used with flexible conduit or armored cable, and I further believe such use never was intended by the code. A review of the UL listing under the heading of "Attachment Plugs" appears to verify this opinion. Some armored cable connectors are listed for use with flexible cord, and previous to the 1959 Code, Table 31 did recognize armored cord, type CA in sizes 18, 16 and 14. Such recognition does not appear in the 1959 Code.

In so far as UL listings are concerned their standards are established on the basis of code rules. I am unable to find where the code recognizes plug caps to be used with armored cable or flexible conduit. As a result I am unable to find where UL recognizes such procedure.—B.A.McD.—3/60/7

Grounding a Circuit Conductor

Q. *Article* 250-23 *states in part: "Grounding Connections for Alternating-Current Systems. Secondary connections for alternating-current circuits which are to be grounded shall have a connection to a grounding electrode at each individual service, except as provided for in Section* 250-21. *The connection shall be made on the supply side of the service disconnecting means."*

Does this mean that I may attach the ground wire to the grounded service conductor at the service head, meter socket, auxiliary gutter or service equipment?—M.W.


Neutral
Meter housing
Neutral bus-bonded to enclosure
Grounding conductor may be connected to neutral at these points
Service equipment enclosure

A. Yes, according to Section 250-52 of the 1959 National Electrical Code, which reads as follows: "Grounding a Circuit Conductor. The grounding conductor may be connected to the grounded circuit conductor at any convenient point on the premises on the supply side of the service disconnecting means."

There are many local inspection and utility rules governing your question. Therefore, you should check your local requirements to avoid any possible conflict.—R.E.W.—3/60/8

Underground Service Cable

Q. *Is there an approved non-metallic or non-shielded cable that can be used in 5-kv underground conduit for service entrances?—G.G.M.*

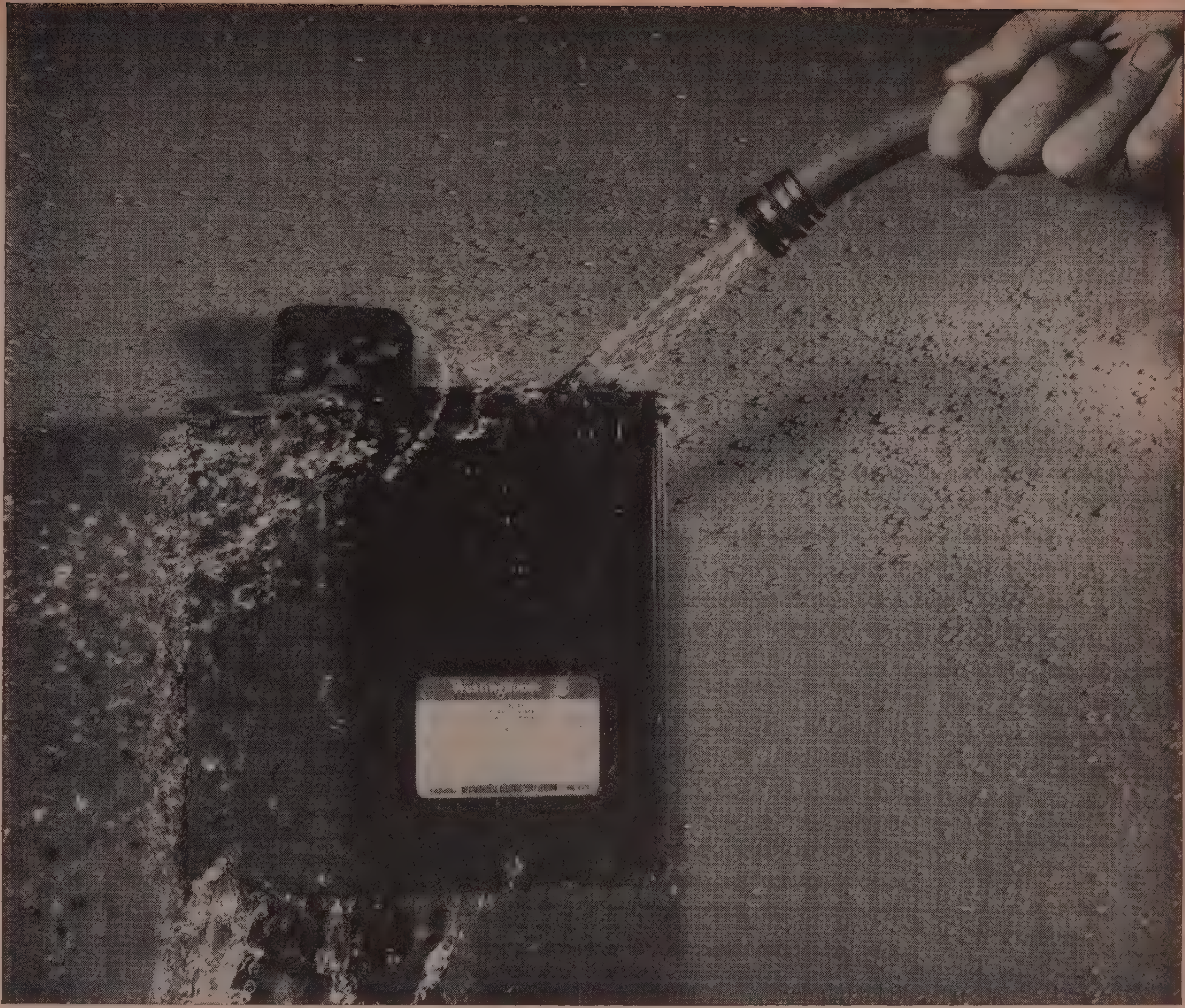
A. We must first come to some understanding as to the word "approved." Codewise this is covered by the definitions found in Article 100, as follows:

"Approved: Acceptable to the authority enforcing this code."

Based on this concept, there are cables manufactured and guaranteed by reputable companies that are "approved" by the local inspection authority. These cables may be installed underground and used as service conductors. The local code authority relying on the integrity of these manufacturers will "approve" these cables for such use.

Approval based upon the fact that some recognized testing laboratory, such as Underwriters' Laboratories, Inc., has such a cable in its "listings" is not as yet forthcoming. The present listing of UL shows both a "Service Drop Cable" and a "Service Entrance Cable" as labeled cable. In general, both of these listings cover cables for a maximum of 600 volts.

Whether or not UL is prepared for higher listings can be best answered by them. It should be pointed out that they do show up to



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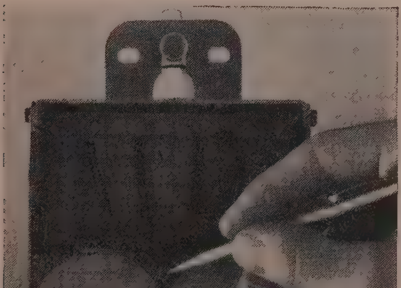

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2. Rubber covering.
3. Varnished cloth.

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I feel reasonably sure that if the demand is created by the inspector for such listing it will be forthcoming.—B.Z.S.—3/60/9

Clothes Dryer Circuits

Q. *Is it a violation of Section 422-2, or Section 210-24 to install a clothes dryer, rated at a total load of 26 amps, to a 30-amp branch circuit? The dryer is on a separate circuit with no other load connected to it.*

I have been told, since the dryer draws more than 24 amps that a 50-amp circuit would be required. My contention is that the 24-amp limitation would apply only if the circuit had two or more outlets. Section 210-24 states:

"Individual branch circuits may supply any loads. Branch circuits having two or more outlets may supply only loads as follows:

(b) 30-Amp Branch Circuits. Fixed lighting units with heavy duty lampholders in other than dwelling occupancies; or appliances in any occupancy. The rating of any one portable appliance shall not exceed 24 amps."

Is an electric clothes dryer considered to be a portable appliance? —J.G.L.

A. The provisions of Section 422-2 read as follows:

"Every appliance shall be supplied by a branch circuit of one of the types specified in Article 210. Motor operated appliances shall also conform to the requirements of Article 430."

As you state, Section 210-24 recognizes the use of an individual branch circuit. Such a circuit is defined under Article 100 as follows:

"A branch circuit that supplies only one utilization equipment."

It appears obvious that the 26-amp dryer in question could be served by an individual branch circuit consisting of No. 10 conductors protected by a 30-amp overcurrent device. The 24-amp limitation applies to a 30-amp branch circuit which supplies more than one utilization equipment. The only rule which may be involved is Section 210-23b which limits the load-

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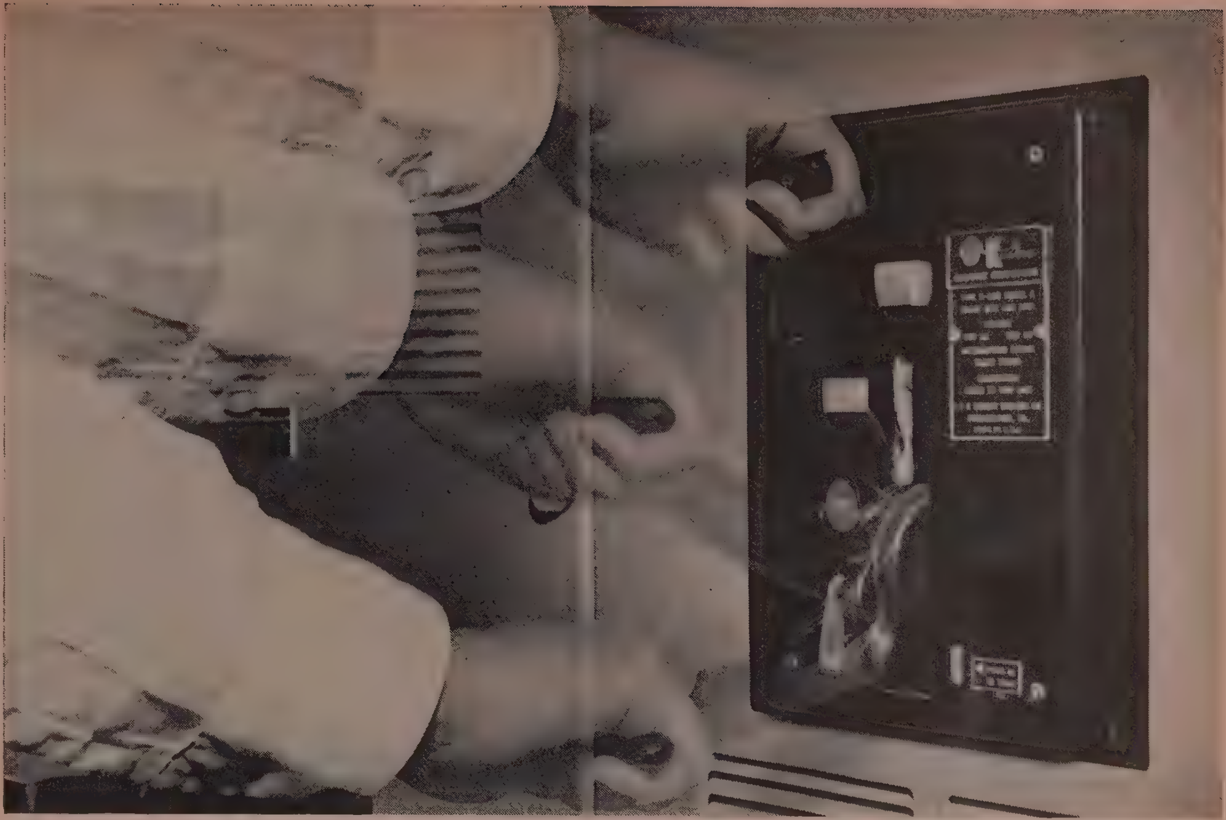

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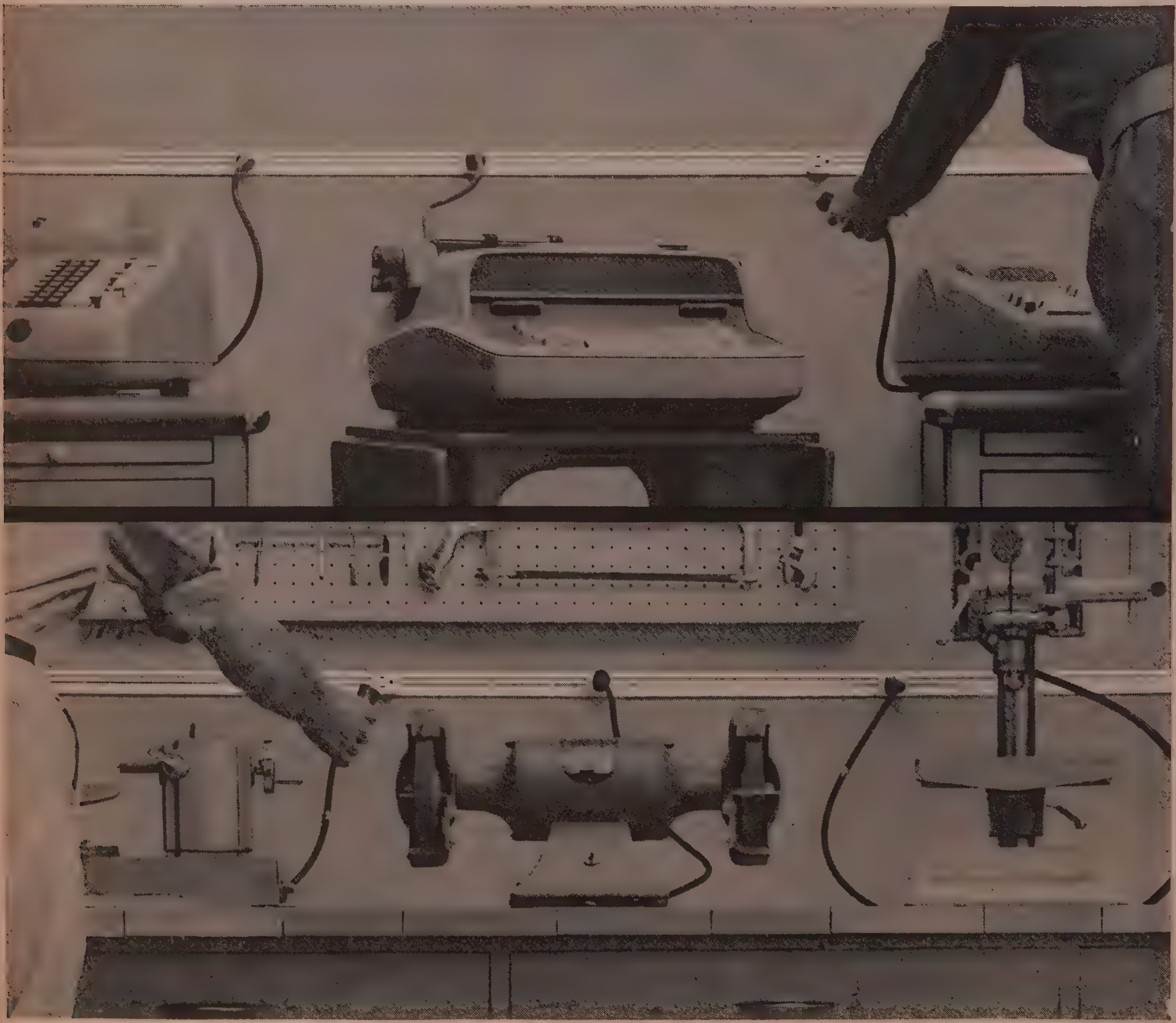

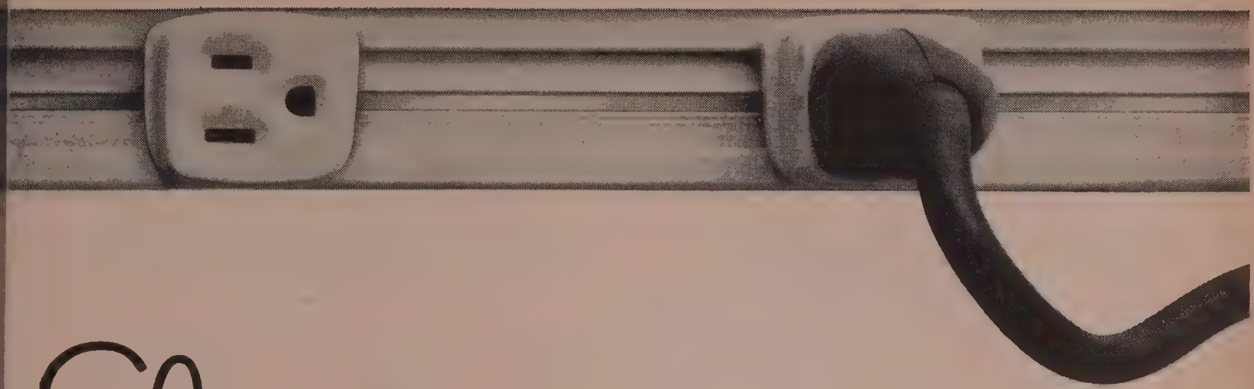

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ing of a branch circuit to 80% when the load continues for long periods of time. Under such circumstances, No. 8 conductors protected at 40 amps should be used. While the code does not cover "long periods of time" some authorities believe that a panelboard subject to continuous loading for three hours is considered to be a long period of time. I doubt very much that the question of continuous loading applies to a dryer in a residential or a commercial occupancy. The very nature of its use indicates intermittent operation.

The definition of a portable appliance, which reappears in the 1959 code indicates a cord, plug, and receptacle connection. The provisions of Section 400-3 tells us where flexible cords may be used. The provisions of Section 250-45 (c) recognizes a clothes dryer as portable equipment, which must be grounded when installed in a residential occupancy. I believe that a dryer connected by the use of a cord, plug and receptacle may be considered to be a portable appliance the same as an electric range. The distinction between the terms portable, stationary and fixed is not definitely established at the present time. A study now under way will endeavor to clarify the intent of such terms. —B.A.McD.—3/60/10

Disconnect—Hermetic Type Compressors

Q. *We have a single-phase 220-volt condenser unit, UL approved for outdoor installation. It uses the furnace motor for the blower.*

The compressor motor is rated at 16 amps with a locked rotor current of 70 amps. The fan motor is $\frac{1}{8}$ hp rated at 1.2 amps, making a total of 17.2 amps.

The running load of 16 amps would indicate a 3-hp motor and the locked rotor current of 70 amps would indicate a 2-hp motor, so we use the larger rating of 3 hp.

The National Electrical Code lists a 3-hp single phase motor at 17 amps. The total running load of this unit is 17.2 amps. As this unit exceeds the 3-hp rating by two tenths of an amp, will it be necessary to have a 5-hp rated switch installed or will it be permissible to uase a 3-hp rated switch?—C.H.C.

A. For the convenience of our readers, the provisions of Section 430-110 (b) cover the carrying capacity and interrupting

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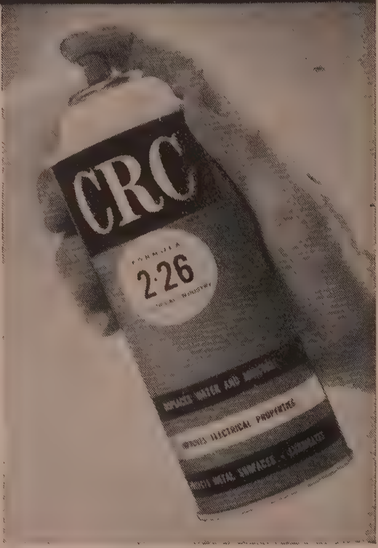

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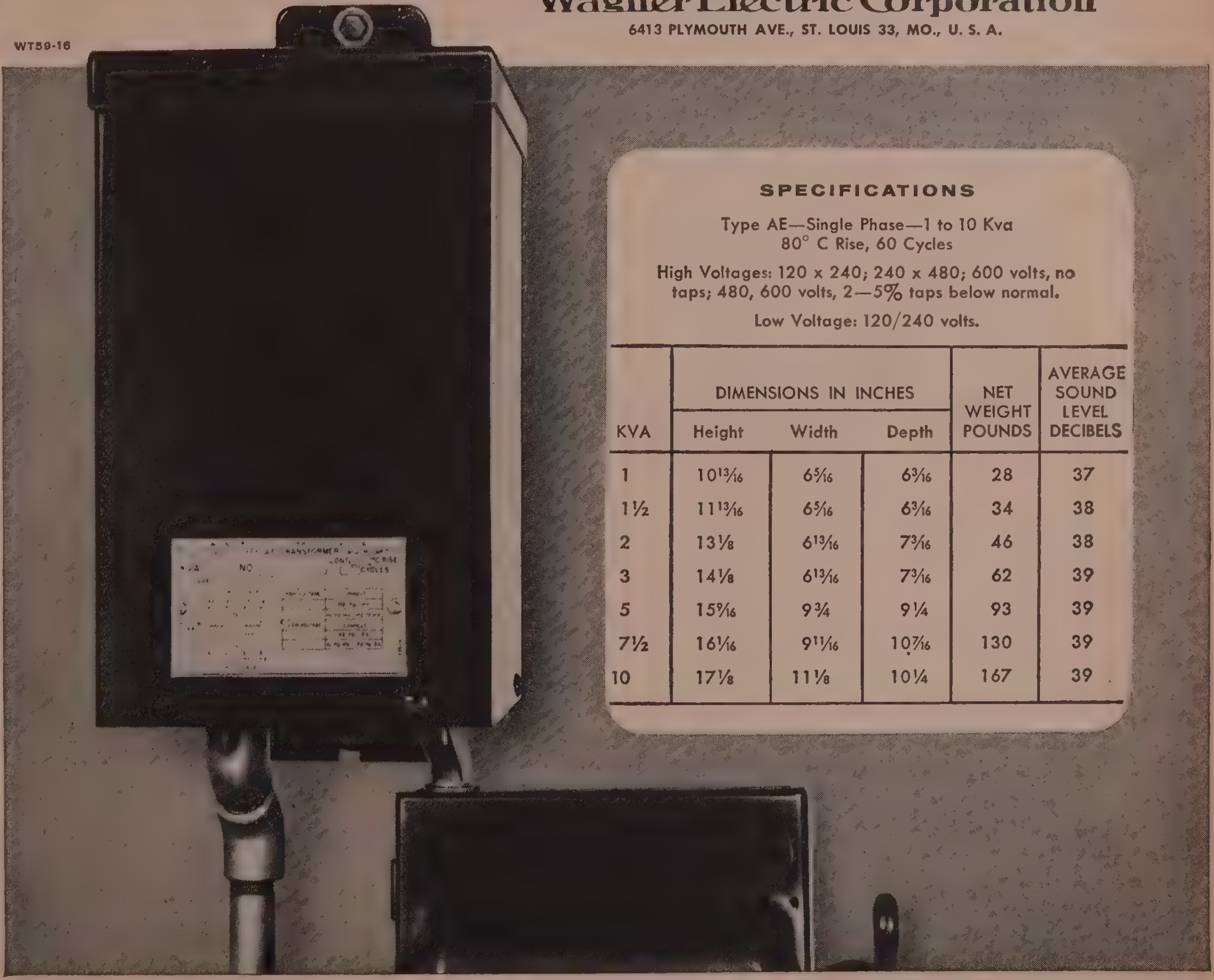

SPECIFICATIONS

Type AE—Single Phase—1 to 10 Kva
80° C Rise, 60 Cycles

High Voltages: 120 x 240; 240 x 480; 600 volts, no taps; 480, 600 volts, 2—5% taps below normal.

Low Voltage: 120/240 volts.

	DIMENSIONS IN INCHES			NET WEIGHT POUNDS	AVERAGE SOUND LEVEL DECIBELS
KVA	Height	Width	Depth		
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1½	11 13/16	6 5/16	6 3/16	34	38
2	13⅛	6 13/16	7 3/16	46	38
3	14⅛	6 13/16	7 3/16	62	39
5	15 9/16	9¾	9¼	93	39
7½	16 1/16	9 11/16	10 7/16	130	39
10	17⅛	11⅛	10¼	167	39

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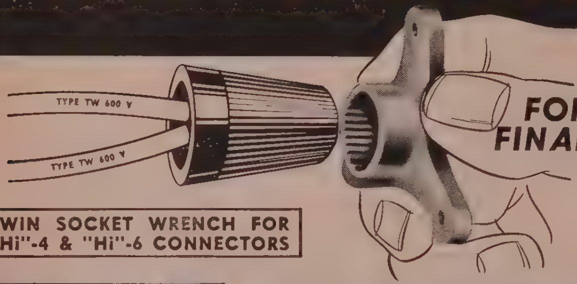

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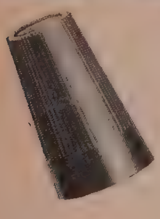

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capacity of the disconnecting means for a sealed (hermetic type) refrigerator compressor motor. This rule reads as follows:

"(b) The disconnecting means for sealed (hermetic-type) refrigeration compressors shall be selected on the basis of the nameplate full-load current and locked-rotor current, respectively of the compressor motor as follows:

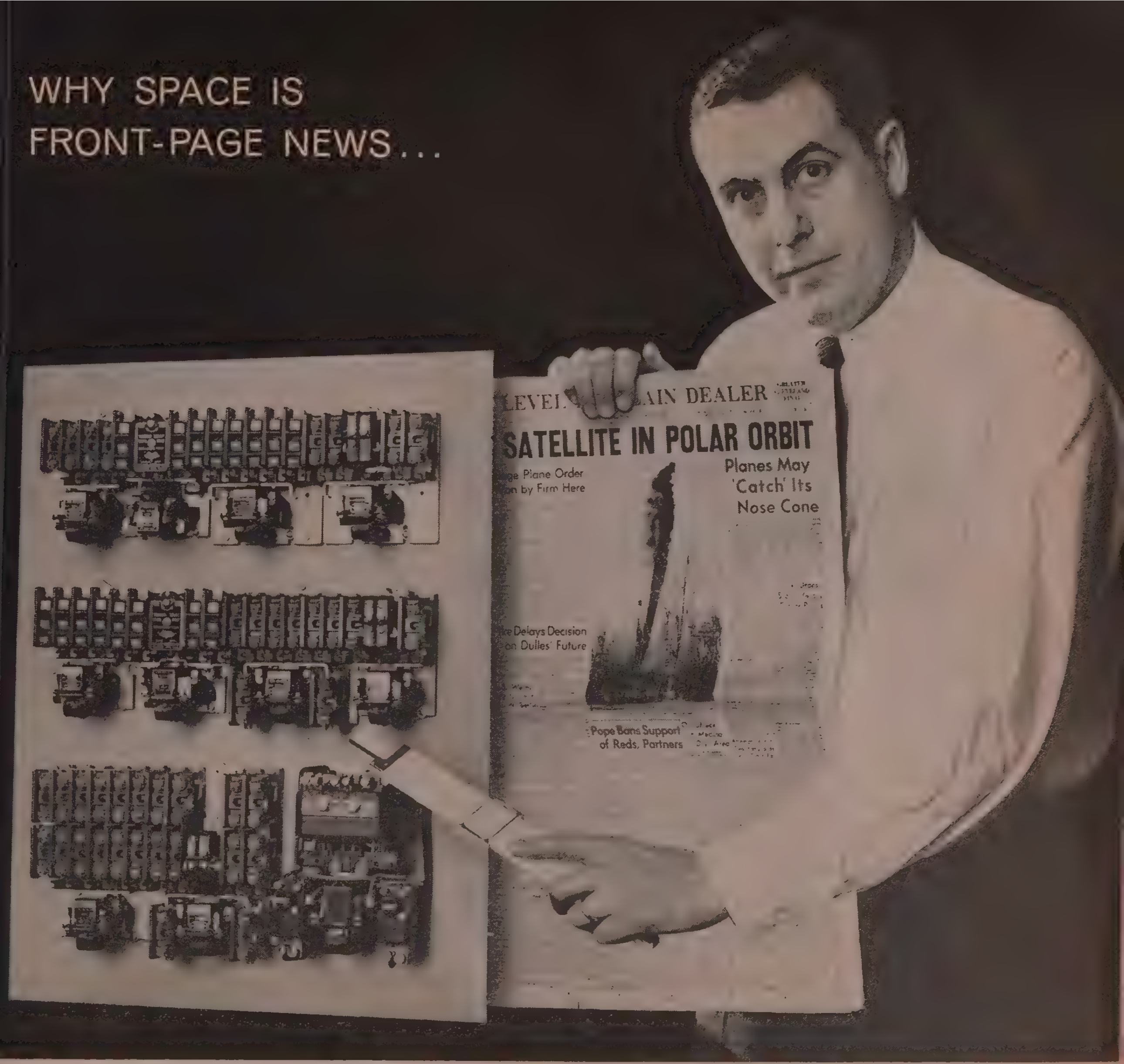
(1) The carrying capacity shall be at least 115% of the nameplate full-load current.

(2) To determine the equivalent horsepower in complying with the requirements of Section 430-109, select the horsepower rating from Tables 430-148, 430-149, or 430-150 corresponding to the full-load current, and also the horsepower rating from Table 430-151 corresponding to the locked-rotor current. In case the nameplate full-load current and locked-rotor current do not correspond to the currents shown in Tables in Sections 430-148, 430-149, or 430-150, respectively, the horsepower rating corresponding to the next higher value shall be selected. In case two different horsepower ratings are obtained when applying Tables 430-148, 430-149, or 430-150, or Table 430-151, a horsepower rating at least equal to the larger of the two values obtained shall be selected."

The provisions of Section 430-112 recognizes the use of one disconnecting switch for more than one motor under the following conditions:

"The disconnecting means shall have a rating not less than is required by Section 430-109 for a single motor the rating of which equals the sum of the horsepowers or currents of all the motors of the group."

The full load current of the two motors in question is 17.2 amps. According to Table 430-148, a single-phase, 230-volt motor, with a full load current of 17.2 amps has a 5 hp rating. If the current were 17 amps, the rating would be 3 hp. In other words a current of .2 of an amp changes the hp rating of the motor from 3 to 5 hp. A motor with a full load current of 28 amps is also rated at 5 hp. On the basis of full load current it appears that a 5 hp rated switch is required. It is possible that such a horsepower rated switch would have a current rating of 60 amps, which is about 35% of the full load current of the motor. It follows however that the provisions of Section 430-110 (b-1) would be satisfied if a switch rated at 115% of 17.2 amps or 20 amps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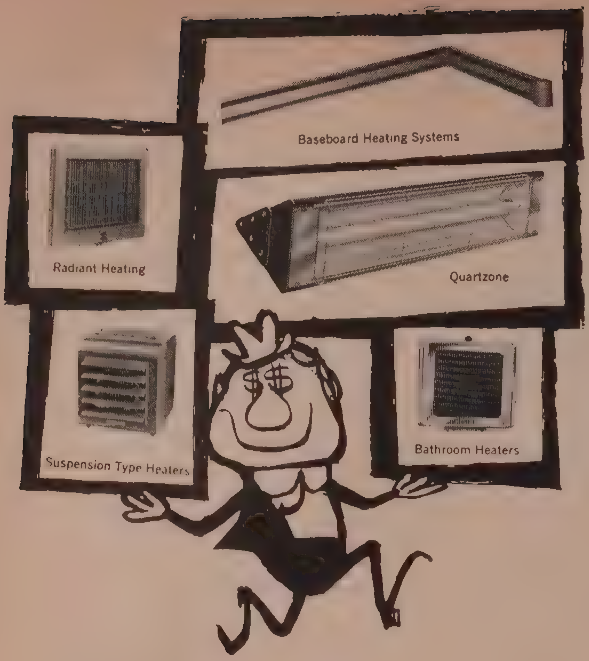

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were used. A 3-hp rated switch would have a current rating of 30 amps which is 170% of the 17.2-amp rating of both motors. While the above logic indicates that the current capacity of a 3-hp switch satisfies the carrying capacity required by Section 430-110 (b-1), the provisions of paragraph 2 of this section indicate otherwise, and a question of intent immediately arises.

In so far as the locked-rotor current is concerned it appears from Table 430-151, that a 3-hp switch with a maximum interrupting capacity of 102 amps more than satisfies code requirements, since the locked-rotor current of the compressor motor is only 70 amps. The difference between 102 and 70 is 32 amps, which represents the locked-rotor current of a ½-hp motor. It therefore appears that a 3-hp switch has sufficient interrupting capacity to safely interrupt the locked-rotor currents of both motors. This raises another question with respect to code intent. When more than one motor is involved, does the code require the disconnecting means to interrupt the stalled-rotor current of both motors? According to the provisions of Section 430-109 (a), the code recognizes the branch circuit overcurrent device as a means of disconnect for a ⅛-hp motor. This code rule shows little concern with the slow process of interrupting the full load and locked rotor current of a ⅛-hp motor. The fact remains however that such a rated motor, in the case in question, could influence the use of a 5-hp instead of a 3-hp switch. In other words we need the additional 2 hp to take care of the ⅛-hp motor.

In view of the foregoing observations, I am inclined to believe, on the basis of code intent, that a 3-hp rated disconnecting switch would satisfy the degree of safeguard intended. This appears obvious to me regardless of the formula covered by Section 430-110 (b-2). On the basis of hazard, I don't believe the .2 of an amp would warrant the use of a 5-hp switch with a current capacity of 60 amps. The status of a fraction of an amp should be established by the code. Some authorities eliminate such fractions when computing the size of the various components of a wiring system. Such procedure is questionable on wiring installations subject to competitive bidding. A contractor who follows a literal reading of the rule may lose a contract to an associate who assumes

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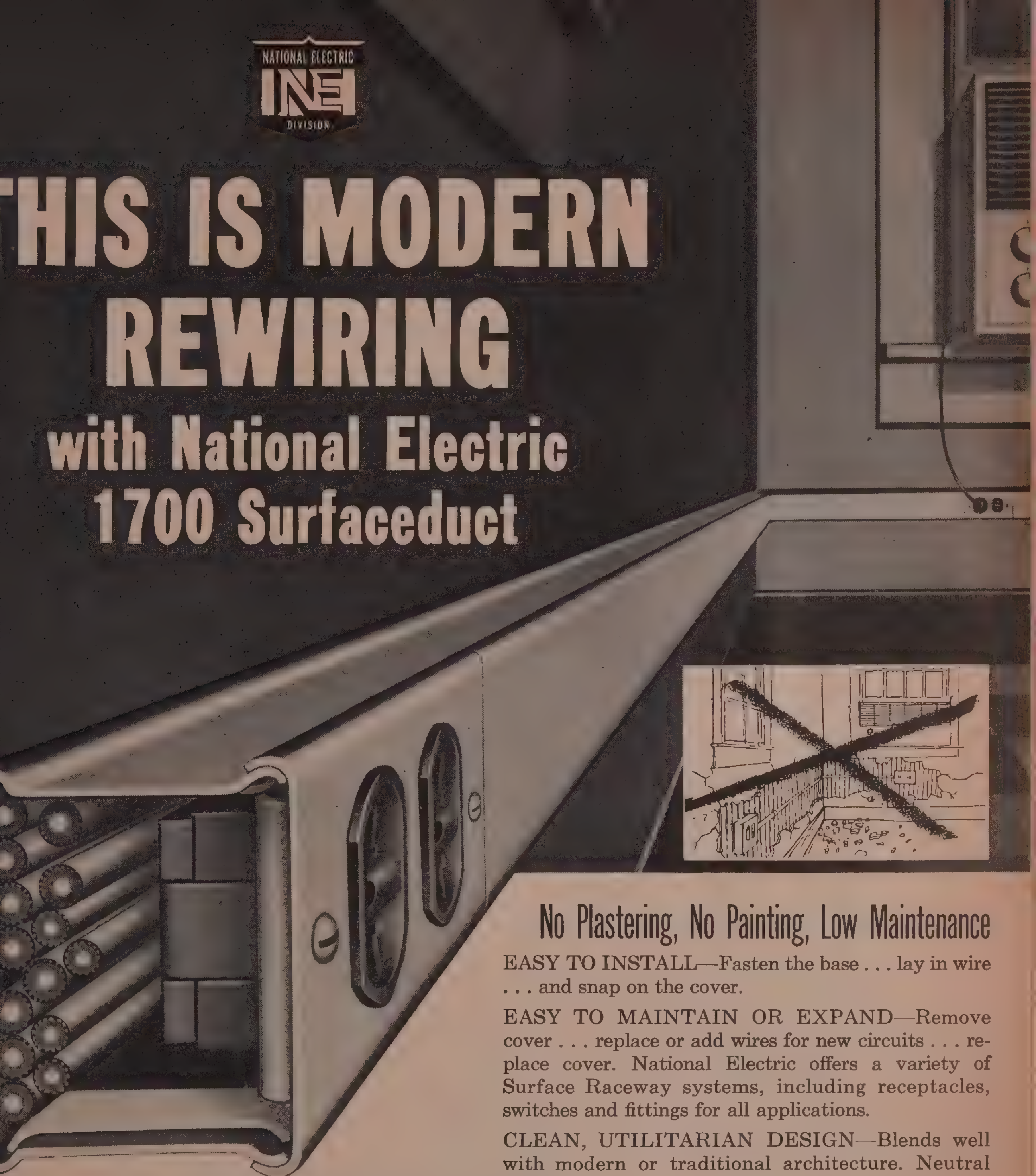

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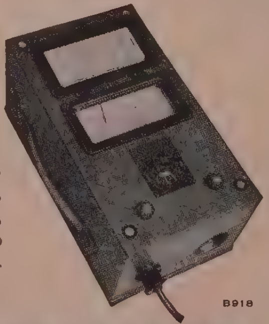

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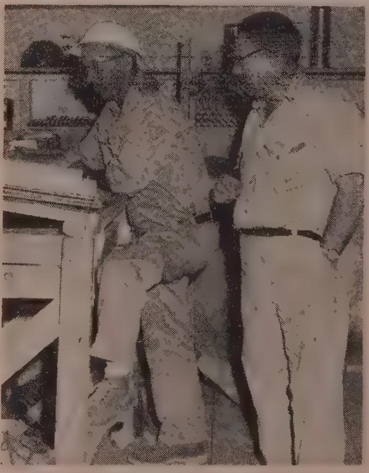
that the inspector is not interested in fractions of an amp. The difference between 3 and 5 hp switches, where many units are involved, could be the determining factor in obtaining a contract. When minor concessions of this nature are given, all contractors concerned should be notified—B.A.McD.—3/60/11

Motor Controller As Disconnect

Q. *May a magnetic motor starter with motor running protection also serve as the motor circuit disconnecting means?—E.D.M.*

A. Section 4407 (430-111) of the code recognizes a switch or circuit breaker as both controller and disconnecting means when the controller or the magnetic motor starter satisfies the provisions outlined under this section. When such a combination is used the circuit breaker must be manually operable, and as required by Section 4384 (430-84) must disconnect all ungrounded conductors serving the motor. It must also satisfy other pertinent rules covered by Section 4383 (430-81 & 430-83) which concerns motor controllers and the provisions of Sections 4401 (430-101) through 4411 (430-112) which concerns disconnecting means.—B.A.McD.—3/60/12



JOBSITE REPRESENTATIVES for Acme-Collins Electric of Reno, Nev., contracting organization for Harrah's swank new 600-seat Lake Tahoe supper club, included general foreman Victor Ericksen and estimator Sam Bisset, pictured above checking details of the elaborate distribution and control system.

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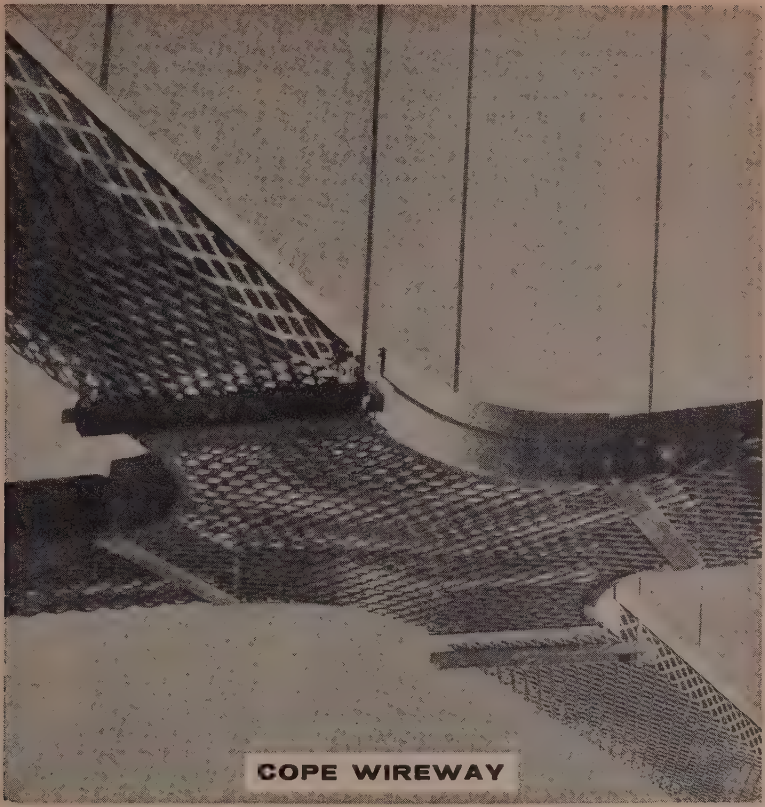
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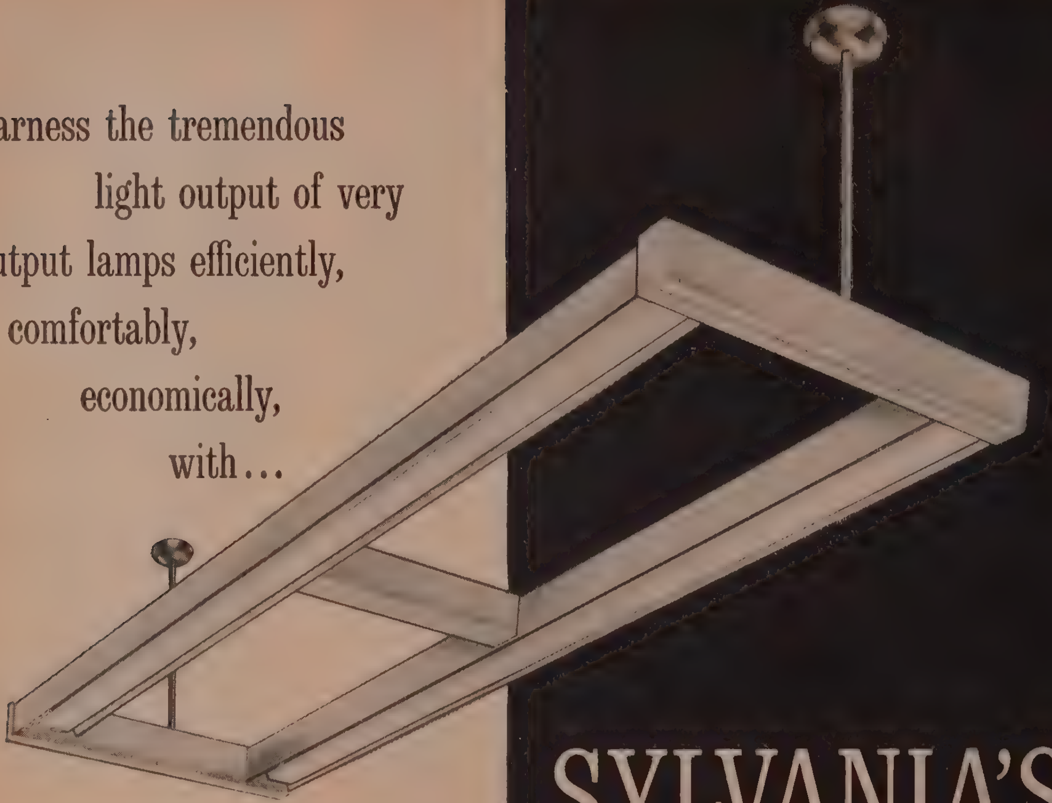

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In the News

Upper Midwest Conference Looks to Electrical Future

A desire to see and hear what the electrical industry future holds for contractors, utilities, wholesalers, manufacturers, inspectors, architects and engineers, brought a record registration of more than 1900 at the 23rd Annual Upper Midwest Electrical Industry Convention and the 10th Biennial Electrical Trade Exposition held February 14-17 at the Hotel Leamington and Municipal Auditorium in Minneapolis, Minn. More than 550 electrical contractors from Minnesota and surrounding states attended the variety of sessions coordinated through the North Central Electrical League and visited the exhibits of some 195 manufacturers and their representatives in the show sponsored by the North Central Electrical Manufacturers Club.

Interest in electric heating from a relatively cold geographical area was evidenced in session topics and the exhibit. Almost half of the meeting subjects dealt with electric space heating and year-round "climate control"—a term that permeated many of the sessions and a target that should raise the promotional sights of the electrical industry. This includes heating, air conditioning, humidification, dehumidification, and air cleaning not only in the home, but in industrial and commercial occupancies as well. Add to this electric cooking, water heating, the array of labor-saving appliances and good lighting and you have a picture of the truly all-electric design.

While sketching the intriguing future of the electrical business, Allen S. King, EEI president and president of Northern States Power Company, predicted doubling of electrical usage in the next decade. Speaking at the all-industry luncheon opening the 3-day convention, he characterized electric heating as the initial step toward the year-round climate control goal. He noted, among other things, that: climate controlled hog houses now permit farmers to produce better hogs in shorter time; farm home lighting is still in the "dark ages"; industrial automation is a "must" to meet foreign competition; industrial plant as well as store and commercial building climate control is a very promising market. Our job is to build up a saturation of present known uses of electricity, then go beyond and develop new applications, he concluded.

Electric Heating Sessions

Contractors are interested in electric heating. This was clearly indicated by their attendance at the numerous sessions touching on this subject. All facets of electric heating were covered: planning, insulation, heat loss, equipment design and application, market potential.

A new approach to promotion of electric heating was explored by Jack Forciea, Edwards Sales Co., Minneapolis and George Jensen, Tem-Trol Corp., Minneapolis. Use electric heating in industrial and commercial buildings to gain public acceptance. Employees may then want it in their homes, as was the case with air conditioning, Mr. Forciea believes. He revealed that a committee is now working on establishing a set of suggested standards for commercial and industrial electric space heating as a good starting point.

Mr. Jensen advised that the equipment cost for properly controlled indoor climate in commercial and industrial buildings can be justified if employee efficiency and production increases as little as 1% to 1½%. Minimum increases up to 9.5% can result, he noted. Control of atmospheric pollution (electric air cleaning) is a phase of climate control that may well develop into an important market by itself, he concluded. Perhaps the crux of

1960 OFFICERS of the Minnesota Electrical Association are: (L to R) secretary—Louis Kasperek, LeSueur; treasurer—Robert DeWar, Fairmont; president—Bert Gordon, Albert Lea; vice president—S. J. Berquist, Litchfield; manager—Harry Kane, Minneapolis; advisory director-at-large and immediate past-president—Gene Burton, Brainerd, Minnesota. All were elected at the recent 32nd Annual Meeting of the Association in Minneapolis.

LOUIS K. COMSTOCK, (center) founder of L. K. Comstock & Company, Inc., New York City, celebrated his 95th birthday on January 8. Shown with him are George F. Nicol, treasurer; Charles L. Scharfe, Sr., executive vice president; Charles L. Scharfe, Jr., vice president; and John W. Frommer, president.

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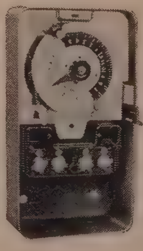

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electric heat sales and promotion was expressed by Carl Bremicker, Northern States Power Company, when he noted that all branches of the electric industry are interdependent and must work together and that there is a need for a "unanimity of desire" to sell value instead of price.

Speakers on electric heating subjects included: J. D. Spencer, Wood Conversion Co., St. Paul; Harold Mattlin, Anderson Window Co., Bayport, Minn.; Ellwood Johnson, Rural Cooperative Power Association; Lowell Mast, Electromode Corp., Rochester, N. Y.; Stanley Aronson, Berko Electric Mfg. Corp., Queens Village, N. Y.; J. T. Mellon, Wesix Electric Heater Co.. San Francisco, Calif.; Fred Kimball, Kansas Gas & Electric Co., Wichita, Kansas.

Codes Meeting

One full evening was devoted to the annual all-industry wiring code session sponsored by the Minnesota Chapter, IAEI, and moderated by Francis Fritz, chairman of the Chapter. John S. Chapman, educational director, Fyre-Fyter Co., Dayton, Ohio, reminded those present of the $183 million damage caused by electrical fires last year and reiterated the importance of electrical fire safety. Stating that the NEC has the sharpest teeth of any code in the U. S., he cautioned against "cheating safety for the sake of price."

At the open forum period, it was revealed that both Minnesota and North Dakota are asking that 100% demand factors be applied to electric space heating loads (Code Table 220-7) because of the climate

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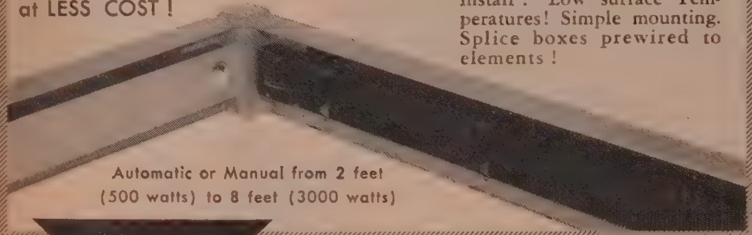

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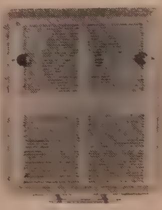

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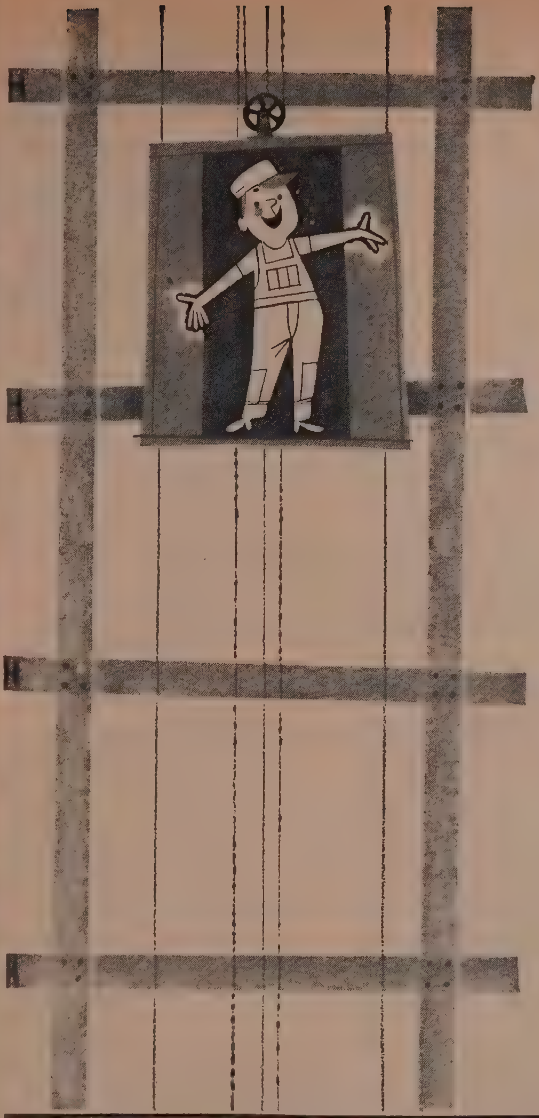
START WITH a good electrical job and sell its values—not price—W. N. Collins, president, Collins Electric Construction Co., St. Paul, Minn., advises registrants at the recent Upper Midwest Electrical Industry Convention in Minneapolis.

conditions encountered in these areas. Numerous written and floor questions were answered by a panel composed of the following inspectors: Leo Nagel, North Dakota State Board of Electricity; Elroy Reberg, Vernon Christensen and Dave Squiers, Minnesota state electrical inspectors; Martin Streed, chief electrical inspector, Minneapolis; Paul Shillock, electrical inspector, St. Paul; and S. M. Sanford, Minnesota State Board of Electricity.

Contractor Forum

At a forum session sponsored by the Minesota Electrical Association and the Twin City Chapters, NECA, Henry Esch, electrical engineer, Kaiser Aluminum & Chemical Sales, Inc., Newark, Ohio, pointed up the design, installation and operating features of aluminum conduit and cables; emphasized weight advantages and the short circuit capacity of aluminum conduit as a safety factor; offered numerous helpful hints on installing and connecting the aluminum circuit components.

James /V. Gaynor, Gaynor Sales Agency, St. Paul, warned contractors that air conditioning manufacturers are coming into the electric heating field; noted that the largest distributors and installers of electric home heating were not in the electrical field a few short years ago; revealed that warm air heating contractors are establishing electrical departments to sell and install electric heating. He suggested that electrical contractors grab the ball and establish themselves as electric heating specialists in their respective areas; predicted 5 million completely electrically heated homes in the U. S. within the next eight years.



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General Electric makes four types of underfloor wiring systems—everything you need in order to handle any combination of electrical and structural requirements, in any size or type of building. The examples below show you which G-E system goes with each type of floor construction.

EASY INSTALLATION! All General Electric systems are designed for easy installation. For example, with the G-E single-level duct systems, center-duct runs can be fed through the conduit openings in the corners without need for field adaptations. Junction boxes can be leveled without removing the covers.

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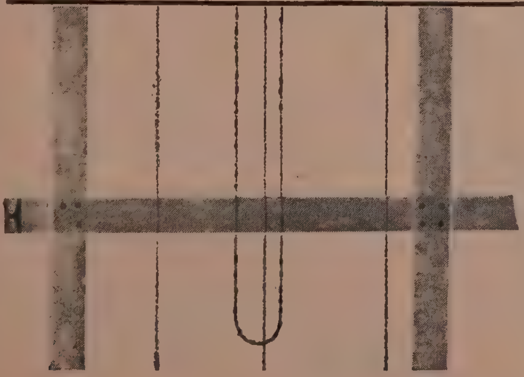
1. For cellular steel floors: The G-E cellular-steel floor wiring system permits outlets on six-inch centers throughout the floor area. Header duct also available for modified cellular floors combined with sections of roof deck.

2. For concrete floors and standard layouts: G.E.'s single-level steel standard duct system can be used in concrete fills as shallow as 2½ inches. Easy-leveling, durable junction boxes have large interiors for quicker wire pulling.

3. For concrete floors and heavy electrical loads: G-E single-level BIG DUCT boasts an 8½ square-inch cross sectional area to accommodate heavy power wiring and multi-conductor communications cables. Can be used in 3-inch minimum concrete fills.

4. For concrete floors and maximum flexibility: G.E.'s two-level duct system permits multi-location feeding without awkward conduit home runs. Feed through the lower level with distribution through the top level. The ideal solution to difficult feeding problems when 3½ inches of fill are available.



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Please send me the bulletins checked below:

☐ Single- and two-level steel underfloor systems.
☐ Cellular-steel floor wiring system.
☐ I have enclosed a description of my underfloor wiring problem. What do you suggest?

Name________________ Title________________
Company________________
Address________________
City________________ Zone________ State________

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RLM INCANDESCENT REFLECTORS
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ALUMINUM WITH ALZAK FINISH. STEEL PORCELAIN ENAMELED. FOR 300-1500 WATT INCANDESCENT OR MERCURY VAPOR 400-1000 WATT NARROW BEAM—MEDIUM OR WIDE SPREAD. THREDLOK SOCKETS.

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CAST ALUMINUM HOUSINGS. PORCELAIN ENAMELED ALL WHITE REFLECTORS. 100-500 WATT SIZES PENDENT, BOX & BRACKET. CLEAR, OPAL & HEAT RESISTING GLOBES.

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FOR SUSPENDED CEILINGS. SERVICEABLE FROM ABOVE OR BELOW. 500 WATT PORCELAIN ENAMELED REFLECTOR. ALSO AVAILABLE WITH CAST ALUMINUM GUARD. SURFACE MOUNTING TYPE ALSO AVAILABLE.

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HOSPITAL ROOM-BED FIXTURES
INCANDESCENT DUAL LIGHT GIVES MORE LIGHT WHERE NEEDED. CAST ALUMINUM. VENTILATED FOR COOLER OPERATION. HAS CONVENIENCE RECEPTACLE ON SIDE.

QUALITY MATERIAL

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FLOODLIGHTS
ALUMINUM WITH ALZAK FINISH. HINGED HEAT & IMPACT RESISTING LENS. FOR INCANDESCENT OR MERCURY LAMPS. ALSO PORCELAIN ENAMELED STEEL ANGLE, OPEN, ELLIPTICAL & ENCLOSED TYPES.

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500 WATT FOR PARKING AREAS. PORCELAIN ENAMELED ALL WHITE REFLECTOR.
COMPLETE LINE OF PAR LAMPHOLDERS, SPLICE BOXES, FITTINGS, COLORED LENS & ACCESSORIES.

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CEILING DRUM TYPE FIXTURES
ALUMINUM ANODIZED FITTER. HINGED QUALITY OPAL GLOBE. FIVE SIZES.

RLM FLUORESCENT INDUSTRIALS
4 & 8 FOOT RAPID START, SLIM LINE, HO & VHO POWER GROOVE.

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FORUM MODERATOR of wiring codes session at recent Convention in Minneapolis was Francis A Fritz, chairman, Minnesota Chapter, IAEI, and state electrical inspector from Detroit Lakes, Minnesota.

Bob Lloyd, Graybar Electric Co., Minneapolis, asked contractors why they "stopped at the outlet"; why they did not "sell up all the electrical features" and provide wiring and load appliances. He suggested a "one-stop service"—appliances, wiring, rewiring and service even if it means using a specialty sales force. He concluded with this question: Why not take a profit from both ends—wiring and appliances?

Lighting Progress

This year, the annual lighting progress report was focused on the Midwest. A highly interesting and informative program under the guidance of John Newhouse, chairman of the Twin City Section, IES, presented evidence of the pace-setting trend established by the Upper Midwest lighting fraternity. Demonstrations of latest equipment items were supplemented by color slides of installations in both small communities and large metropolitan centers. Assisting in the supervision of this stimulating display of the functional and aesthetic applications of modern lighting equipment were V. W. Furey, Don Schwarz, G. M. Fell and L. J. Riegert.

MEA Meeting

Reports presented at the annual meeting of the Minnesota Electrical Association (contractor group) indicate a healthy growth in membership and expansion of services. The estimating workshop held in November was so well received that another 2-day session is scheduled

MODEL 243
Shown using new Skil Rotary Bit for fast masonry drilling

MODEL 78
Shown using shatterproof Skil Hole Saw

MODEL 268
Shown using new Skil Self-feeding Bit for drilling without pressure

3 Skil drills that'll save you plenty

in dollars . . . in hours . . . in effort on the job!

Skil ¼″ Model 243 Drill has "in line" rear handle for better control and direct application of pressure. Powered and geared for rugged day-in and day-out drilling in metals, masonry, tile, wood. Saves replacement costs of bits that often break or dull under the strain of stalling in less powerful drills.

Skil ⅜″ Model 78 Drill combines compact, lightweight pistol grip design with a convenient side handle for positive two hand control. The result—easier, safer, more accurate drilling. Side handle quickly removes for close quarter drilling. Has the powerful, high torque and extra chuck capacity so often required.

Skil ½″ Model 268 Right Angle Drill gets in tight quarters, between joists and studding. New self-feeding bits let you drill big holes—from 1¼″ to 2⁹⁄₁₆″—without bearing down on the tool. Cuts operator effort and fatigue. For straight-line drilling, simply remove right angle unit. Comes complete with carrying case and 2⁹⁄₁₆″ self-feeding bit.

There are 14 other quality-built SKIL drills, too, from compact ¼″ models to ¾″ and 1″ big jobs. Ask your SKIL distributor for demonstrations. He's listed under "Tools—Electric" in the Yellow Pages. Or for full information write: Skil Corporation, 5033 Elston, Chicago 30, Ill. Dept. 130 C

SKIL . . . and SKILSAW POWER TOOLS

The "TRU-LEVEL" Adjustable FLOOR BOX is EASY to INSTALL

The #190 "Tru-Level" box is a standard 4 inch octagon, sheet steel box—and is watertight.

Concrete can be poured to very top, also to box-body height only. A second tin lid is provided.. The box-body has a 3¼" opening, making it easy to get hand into for conduit attachment or wire-pulling.

A skin tight plastic collar seals out moisture while protecting the adjusting-ring threads and also keep open an avenue for hand to fit down thru concrete.

Adjusting-ring is designed to fit all popular size and style receptacles—you simply clip off plaster ears and drop into place.

Listed under re-examination services of Underwriters Laboratories, Inc.

"Latrobe" Pipe or Conduit Clamp

This clamp is made with a double safety bite of case hardened tool steel. Two models — Right Angle and the Parallel support. Each model comes in 11 sizes to handle pipe or conduit ⅜" thru 4".

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CHIEF INSPECTOR of the North Dakota State Board of Electricity, Leo Nagel, Bismark, N.D., was prominent member of the Code Panel at Upper Midwest Electrical Industry Convention wiring codes session in Minneapolis.

for March 11-12 at the Dunwoody Industrial Institute in Minneapolis under the supervision of Institute instructor Fred Madison. Plans for an advanced 3-day workshop are in the development stage. The MEA Estimating - Accounting Manual, published last year, is a rousing success with sales going to all parts of the country. Scholarship grants (EC&M, Feb. 1960, pg. 190) will be continued.

Contractors throughout Minnesota are getting more skilled manpower. Last year a total of 386 licenses of all grades were issued, according to Francis Judge, MEA member of the Minnesota State Board of Electricity. This is an increase of some 29 over 1958 and 114 over 1957. It includes two (out of six applicants) Class C "installers" licenses established by law last year. This bit of legislation, sponsored by co-op and municipal utilities and retail appliance dealers and vigorously opposed by MEA, NECA, inspectors, and the State Board of Electricitv, permits licensees to install appliances only.

To preclude recurrence of last year's legislative battle, MEA is fostering establishment of an Industry Research Conference Committee to evaluate the practical and economic effects of anv industry complaints or proposals before precipitous action is taken. Such a committee, representing all segments of the electrical industry (REA's, municipal utilities, commercial utilities, manufacturers, inspectors, labor, wholesalers, dealers, contractors), would become a basic sounding-board for industry groups and act in an advisory capacity. This committee, according to Wm. A. Ritt, St. Peter, a founder

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Easy to Use—Hard to Damage

CHOICE OF MOUNTING BRACKETS
UNIVERSAL JOINT
AJUSCO-LOC SOCKET
CHOICE OF REFLECTOR

Exclusive "AJUSCO-LOC" Socket

Ajusco-Loc Socket—Guaranteed not to break, kink, twist, or pull apart.

Put the light where you want it and it stays there—no sagging or slipping. Eliminate costly repairs and lost time with these fixtures that stay on the job and out of the repair shop.

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There's a "right" fixture for every job.

Adjustable
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SINGLE AND 3 PHASE
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Sizes ½ to 1000 KVA
Voltages up to 15,000 V.

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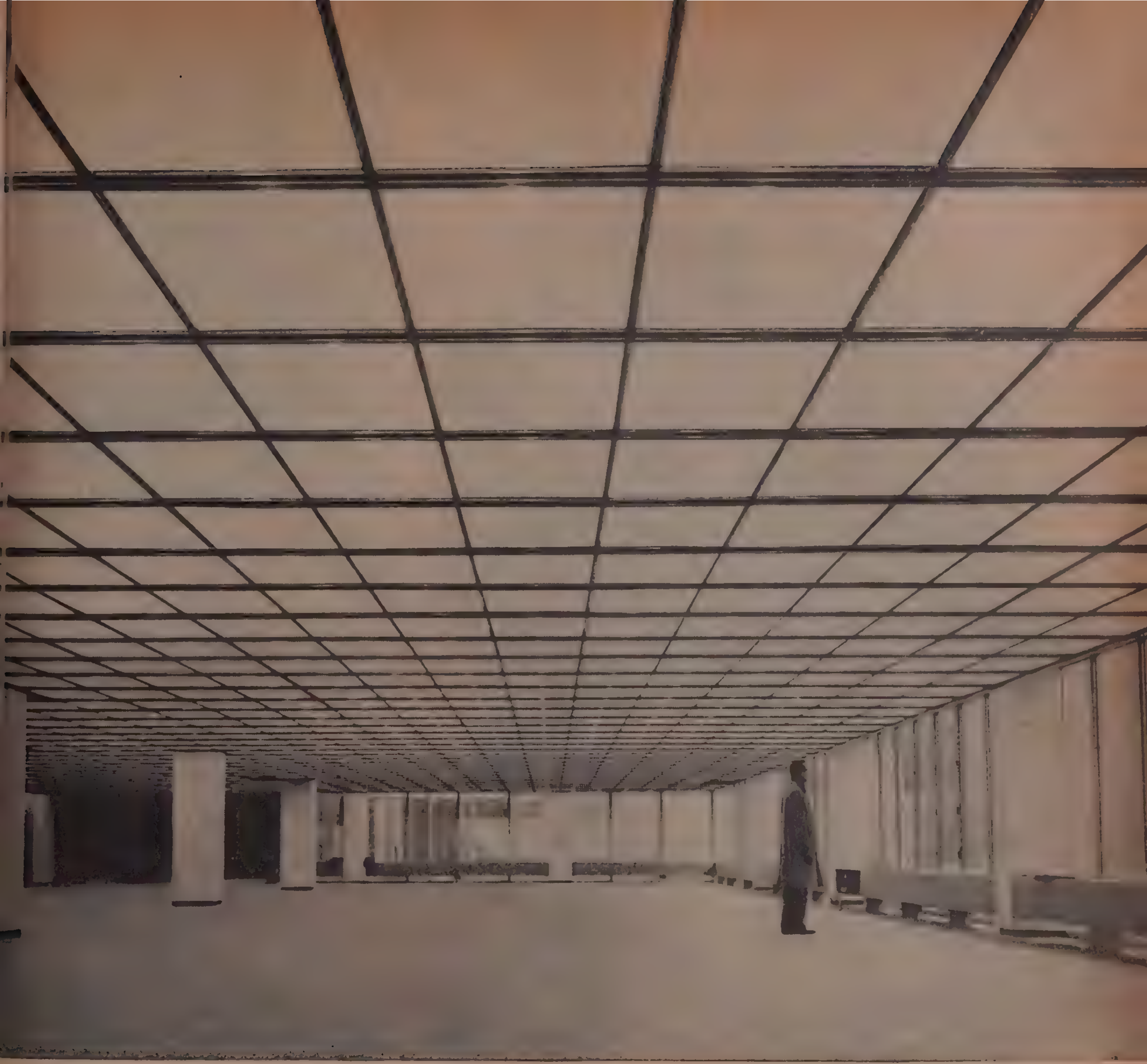

Here's the latest idea in continuous lighted ceilings...

It's in the new Union Carbide building on New York's Park Avenue. The light-diffusing panels of Bakelite Brand rigid vinyl sheets are supported by stainless steel runners that are part of the ventilating and cooling systems and also serve to anchor the movable wall partitions.

Today, you can get Bakelite rigid vinyl sheets that are practically immune to the cracking that raises the cost of installing and maintaining continuous lighted ceilings. That's because these sheets are formulated and fabricated especially for light diffusion. They are expected to last for years without yellowing in standard installations.

They're self-extinguishing, but the installation can be designed so they'll soften and fall out before the sprinkler operating temperature. Installing them with baffles or laminating with special sound-deadening material gives them good acoustical properties. Costs can be cut because much thinner sheets can be used than for other types of diffusers.

There are many other things to look for in Bakelite rigid sheets for continuous lighted and luminous ceilings. If you're not getting them all, write for facts, literature and a list of suppliers, Dept. CM-81K, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Union Carbide Canada Ltd., Toronto, Ont.

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2201 Rocker-Glo Switch

2211 Rocker-Glo Switch and 1432 3-wire Grounding Outlet

Beautiful, new 42-story Southland Center Building in Dallas proudly boasts new P&S Rocker-Glo switches in tenant offices and suites. Rocker-Glo in Despard combinations provides maximum electrical convenience in a single gang plate.

P&S Rocker-Glo switches are designed for use on tungsten filament and fluorescent loads at full current rating . . . can be activated by pressing, pushing, rocking or rolling.

For information, write Dept. ECM-36A

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of MEA and originator of this idea, is now in the organization stage and should contribute substantially to the development of better relations between industry groups and between industry and the public.

Jack Dalton, National Price Service, Cleveland, Ohio, gave the contractor audience a welcome bit of information. NPS is coming out with a price book covering industrial, commercial, fluorescent, incandescent and flood-lighting fixtures.

MEA Officers

At the conclusion of the MEA business session, the following officers were elected: president—Bert Gordon, Albert Lea; vice president—S. J. Berquist, Litchfield; secretary—Louis Kasperek, LeSueur; treasurer—Robert DeWar, Fairmont. Harry W. Kane is the association manager.

Representing the various districts on the MEA Board of Directors are: past-president Gene Burton, Brainerd, Advisory Director at Large; Wm. A. Ritt, St. Peter, Permanent Director at Large; (Dist. 1) Frank Adair, Rochester, and Lyle Pike, Owatonna; (Dist. 2) J. V. Hiebert, Windom, and Richard Wood, Mankato; (Dist. 3) Ruben Obe, Minneota, and Clarence Volk, Madison; (Dist. 4) C. C. Olsen, Perham, and Fred Seibel, Breckenridge; (Dist. 5) M. J. Bischoff, St. Cloud, and A. S. Stadtherr, Sauk Center; (Dist. 6) Earl Odmark, Cambridge, and A. L. Killmer, Osseo; (Dist. 7) Earl Paulson, Brainerd, and Ted Wilson, Mora; (Dist. 8) R. C. Edman, Hibbing, and A. B. Alguire, Chisholm; (Dist. 9) L. W. Best, Thief River Falls, and Percy Johnson, Ada.

FARSIGHTED DESIGN philosophy of W. R. Berndsen, chief electrical engineer, Wilbur Watson Associates, Cleveland Engineering and Architectural firm, encompasses planning electrical systems for inevitable future growth.

STOCK MANAGER of the F. D. Hayes Electric Co., Lansing, Mich., is Fred Cook. Fred, shown here "taking an order," is responsible for keeping the company's men in the field supplied with materials.

NISA News

Plans for NISA's first Regional Practical-Technical Seminar, under the direction of Arthur C. Roe, staff engineer, are nearing completion, and the first pilot session will be held in St. Louis on March 25-27 at Missouri Electric Works.

The meeting will spearhead a program of a series of five or six regional meetings at which personnel of electrical apparatus service shops will test and learn to use new insulation materials.

Under the plan, the association expects to obtain factual, practical data on insulating materials as well as wire, shop tools and equipment.

The program calls for participating manufacturers to send representatives to the meetings to instruct shop personnel in the proper use of their products. A wide range of tests will be conducted, including the making of mush, form, edge wound and one-turn coils of various voltage for direct and alternating current.

• • • •

The new Prom Motor Hotel, Kansas City, Mo., will be the site of the spring meeting of Heart of America Chapter March 18-19. Registration, a reception, dinner, a movie, a business meeting, speeches and discussion comprise the program.

• • • •

Shop owners from Wyoming, New Mexico, Kansas and Nebraska as well as Colorado are expected to

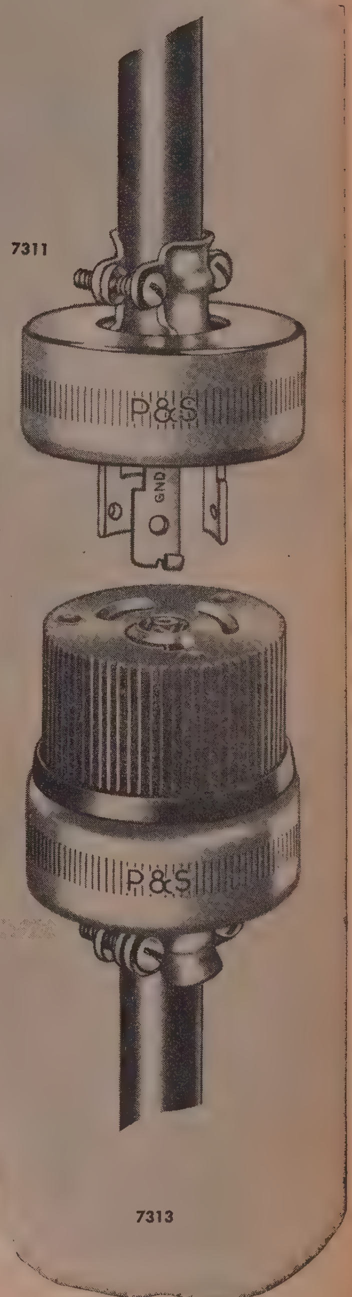
P&S TURNLOK

Built to Take It

P&S TURNLOK wiring devices are designed to give trouble-free service no matter how tough the going gets. TURNLOK devices are available in 10 and 20 Amperes, 2-, 3-, and 4-wire types: receptacles, connectors and caps.

All P&S TURNLOK devices have extra large head binding screws and ample wireways for quick, easy wiring. Armored sections are anchored securely. Cap blades are positioned accurately. Contacts are anchored securely. Fastening screws in connectors are secured in body . . . cannot fall out in wiring. Ratings are plainly visible.

For information about P&S TURNLOK Line, write Dept. ECM-36B.



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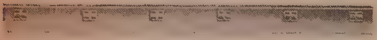
PLUGMOLD

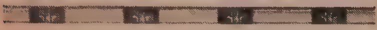
PLUGMOLD 3000, for standard single-gang box devices. Holds, without devices, up to 10 No. 6 conductors.

GIVES



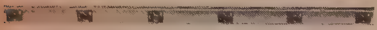
PLUGMOLD 2200 serves as baseboard, multi-outlet system, perimeter raceway. Holds up to 10 No. 10.

MORE



PLUGMOLD 2100, for Wiremold devices rated at 15A, 125V; 10A, 250V. Without devices, holds up to 5 No. 6 conductors.

OUTLETS



PLUGMOLD 2000 has pre-wired sections for short runs, Snapicoil for long runs. Holds 3 No. 12.

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TELEPOWER is pair of parallel Plugmold raceways, one for communications, one for power and light.

LESS

ONE-PIECE raceway by Wiremold comes in four sizes for surface wiring of any building, new or old.

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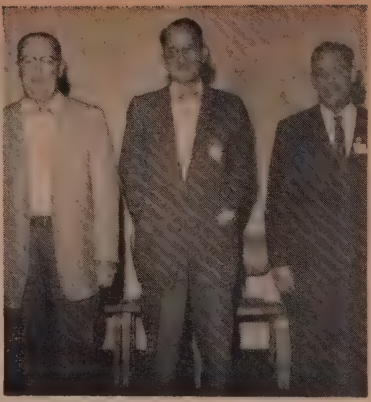

NEW OFFICERS of NISA's Southeastern Chapter are (l-r): President—Lewis S. "Lew" Bain, Jack's Electric Motor Repair, Inc., Fort Lauderdale, Fla; Vice-President—F. E. "Jimmy" Cook, Electric Equipment Co., Augusta, Ga; Secretary-Treasurer—Roy E. Shinault, Roy's Electric Motor Service, Richmond, Va.

---

attend the Rocky Mountain Chapter's spring meeting in Denver March 18-19.

• • • •

Russell Smith, Hysol Corp. of Canada, talked on epoxy encapsulation with slides of work performed at Jenkins Electric, London, Ont. at the January 23 meeting of Ontario Chapter at Lord Simcoe Hotel, Toronto. Arthur C. Roe, NISA engineer, described the association's plans for technical seminars; and Ralph Buscarello, Stewart Warner Corp., discussed precision balancing. The next meeting will be held in London, Ont., April 2.

• • • •

Robert Allen, manager, group sales, New York Life Insurance Co., described NISA's new major medical program at a meeting of the St. Louis chapter at Ruggeri's Restaurant February 10. Norm Frese, National Electric Co., was elected president; Al Martin, Zeller Electric Co., vice-president; and Harold Willmann, Briner Electric Co., secretary-treasurer.

• • • •

Southwestern Chapter will meet on March 10-12 at Baker Hotel, Dallas. Chairman of the meeting is Connie H. Henry. New members of the chapter are: B&B Electric Service, New Braunfels, Texas; Southwest Electric Motor Service, Dallas; and Industrial Electric Service Co., Carlsbad, New Mexico.

• • • •

Herbert Connor of the Massachusetts Dept. of Labor & Industries' Div. of Apprentice Training described the state's program at a meeting of New England Chapter Feb. 11 at Hotel Bradford, Boston.

KATOLIGHT PORTABLE POWER PLANTS give your crews "plug-in" electricity anywhere, whenever it is wanted. Here is a handy dependable electric power to operate all types of power tools to provide steady, bright flood lighting.

Standard sizes and models for every portable, standby or continuous use from 350 watts to 125 KW.

Special Units up to 750 KVA to meet specific requirements.

Yes . . . with instant, dependable electrical power on the job, work speeds up . . . costs go down.

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POW-R-SPADE GUARANTEES PRODUCT & PERFORMANCE!

- Stampings has over five year's experience in building trouble-free, productive trenchers.
- Stampings has sold more trenchers in their class than all other manufacturers combined. There is a reason.
- Shipment made within 1 day after order, and completely assembled, ready to work.
- Pow-R-Spade digs straight, curves, angles without preliminary set-up. Trenches 3" wide to 24" deep—or 4" wide to 18" deep.
- Dealers in principal cities.

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New members of the chapter include: A.J.M. Electric Motor Service, Taunton, Mass.; L. & R. Electric Motor Repair, Chicopee, Mass.; Acme Electric Service & Machine Co., Cambridge, Mass.; L. B. Anthony Co., Lynn, Mass.; and Ralph Dilger, Dow Corning Corp.

A foremen's meeting will be held in Springfield, Mass. on March 19 at Sheraton Kimball, jointly sponsored with the Connecticut Chapter.

• • • •

A member of the Nassau-Suffolk Chapter of the New York Society of Certified Public Accountants addressed the January 21 meeting of New York Chapter at Hotel Shelburne. His topic: knowing the costs of the operation of your business. The chapter's annual "Ladies' Night" was held February 20 at the Shelburne.

• • • •

"To bring to small business some of the advantages of large business" is the function of NISA, International President Horace C. Blenkhorn told 84 members and guests at a meeting of Quaker City Chapter January 27 at Beck's Restaurant.

• • • •

Central Ohio Chapter met on February 10 at Ann-Ton's Restaurant, Columbus.

• • • •

C. A. Sievert, Roy T. Hyre, George Heitshu, Walter Lucke, C. B. Kaska, and George W. Clausing were presented with NISA 50-year awards by International President Horace C. Blenkhorn at the January 12 meeting of Chicago Chapter at Braemere Hotel. A tour of the Allis-Chalmers plant in Mil-

JOHN S. McDERMOTT, retiring president of the International Association of Electrical Leagues, voiced the theme of that organization's annual conference when he stated that "Where There's a Strong Association, There Is A Strong Industry."

Remington Stud Driver

Most versatile powder-actuated fastening tool made

The basic Power Unit...

Here's the single basic tool that gives you a new degree of on-the-job fastening versatility. Only *one* basic unit to buy—the Remington Model 455A—for all your fastening applications. Just choose the instantly interchangeable fastening attachment you need to do the job!

Plus choice of 4 fastening attachments...

K-1 1/4" & 3/8" Light-Duty Captive Stud Attachment uses 22 cal. Power Loads. Use where extra safety is needed.

K-2 1/4" Light-Duty Attachment uses 22 cal. Power Loads. Handles 80% of your fastening jobs.

K-3 3/8" Medium-Duty Attachment drives heavy-duty studs with inexpensive 22 cal. Power Loads.

K-4 3/8" Medium and Heavy-Duty Attachment. Uses both 22 and 32 cal. Power Loads. For toughest jobs.

offers greatest single-tool fastening versatility!

The Remington Stud Driver offers these exclusive features:

- Four fastening attachments for light, medium, heavy-duty work, including the special Captive Stud Attachment for extra-safe fastening. No other single tool can cover such a variety of applications.
- Medium-duty fastening—requiring ⅜" studs—can be done with low-cost 22 caliber Power Loads.
- Positive one or two-hand operation at operator's option . . . no buttons or release to hold while fastening.
- Greater variety of applications made possible with instantly interchangeable guards. These 4" square, hollow "safety guards" fit snugly over work, trap spall and dust. More than 40 types are available.

Send coupon for free booklet about the Remington Stud Driver—your best buy in powder-actuated fastening tools!

Remington

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IN CANADA: Remington Arms of Canada Limited,
36 Queen Elizabeth Blvd., Toronto 18, Ont.

FREE POWER TOOL CATALOGS

Remington Arms Company, Inc., Bridgeport 2, Conn. ECM-3
Please send—without obligation—information on Remington Contractor & Industrial Equipment checked below:

☐ Stud Drivers ☐ Air Tools ☐ Chain Saws
☐ Concrete Vibrators ☐ Flexible Shaft Machines

Name_____ Position_____
Company_____
Address_____
City_____ Zone_____ State_____

Fastens In Any Position—Easily, Quickly, Securely!

PAINE'S Versatile, New Junior Beam Clamp

Solves the problem of securing conduits, switchboxes, pipe, etc. onto "I" beams, ceiling channels, web joists or any type of building framework requiring lightweight, flush-mounted fastening. Try some! Write today, or contact your nearest PAINE representative.

- Designed for use with 1" wide and up channels, ¼" and "U" shaped or "I" beam members.
- Can be adapted for a variety of applications, including the horizontal or vertical holding of electrical boxes needed to feed recessed fixtures.
- Also effective for hanging a continual row of lighting fixtures in many styles.
- Assures a hidden method of holding conduit pipe, cable above false ceilings.
- Mounts flush against channel, makes conduit runs neater, more even, stronger.

Works ideally with any Paine conduit clamp.

the best craftsmen always take PAINE'S

THE PAINE COMPANY, 20 Westgate Road, Addison, Illinois

ALL-NEW *Click Dial* ELECTRIC HEAT THERMOSTAT

for better control of electric heat

Here's a thermostat that responds *faster* to both convective and radiant heat. And, it gives more convenience in setting room temperature accurately. As the large dial is turned, each "click" is a change of *one degree!* You'll like it, too, for its easier wiring, faster installation. Write for Bulletin 3205 . . . it's free.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

INSULATION materials and practices were a between-session topic of conversation at the Southeastern Chapter NISA Conference in Raleigh, N. C. recently, between (l-r): Wm. F. Weirich, Lenni Products, Inc., Lenni, Pa., and Jake M Wilcox and J. F. Downer, of J. F. Downer Elec. Co., Lilesville, N. C.

waukee will be made with the Wisconsin Chapter on March 15.

• • • •

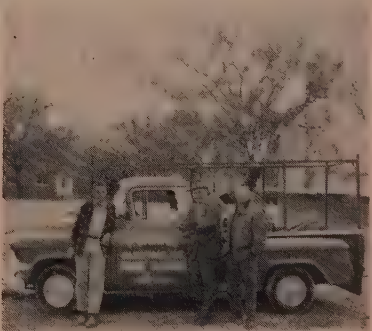
A film on epoxy encapsulation was shown to 16 members of the Cincinnati Chapter by a representative of Allis-Chalmers at a dinner meeting February 3 at Cincinnati Union Terminal.

• • • •

Karl Kauch, of Norma Hoffman Ball Bearing Co., discussed design, selection and care of ball bearings at a dinner meeting of Connecticut Chapter at Waverly Inn, Cheshire, Conn., February 4.

• • • •

Thirty attended the January 14 meeting of King Coal Chapter at Klein Armature Works, Centralia, Ill. At a dinner meeting at Langenfeld Hotel, NISA International President Horace C. Blenkhorn; and Executive Vice President Joseph M. Harrington reported on



JOBSITE PHOTO of trio grouped alongside company truck shows owner, superintendent and foreman of the F. D. Hayes Electric Co., Lansing, Mich. Owner (middle) is Frank J. Hayes; superintendent is Delford Hasty, (left); and foreman is Roland Lutz, (right).

association affairs. Dick George, P. D. George Co., talked on Class F varnish. Mrs. Fred Schlageter arranged a fashion show and travel film for women guests.

• • • •

Leo Kowal, service shop specialist, Metals & Controls Div., Texas Instruments, Inc., addressed the January 19 meeting of Wisconsin Chapter at Moonbi Inn, Germantown, Wisc. Eighteen attended. Mr. Kowal described methods of motor protection meeting original equipment manufacturers' requirements, his company's new service and cross-reference data sheets.

First National House Heating Exposition

More than 3,000 people are expected to attend the first National Electric House Heating Exposition, scheduled for March 21, 22 and 23 in the Sherman Hotel, Chicago, Ill., according to estimates determined at a recent meeting of the Planning Committee. The Exposition will be sponsored by the Electric House Heating Equipment Section of the National Electrical Manufacturers Association.

A symposium will be conducted in connection with the Exposition with key spots on the 3-day program shared by leading manufacturers, power suppliers, electrical distributors, electrical contractors, bankers, architects, builders and representatives of UL.

Subjects will include discussions on new insulation techniques, heat losses, electric heating promotions, distribution of electric heating equipment, interpretations of the National Electrical Code for electric heating installations, unit heaters vs. central systems, standards, sales problems and opportunities, rate schedules, sales training programs for contractors and distributors, electric heating installations as viewed by investment bankers and mortgage firms, applications of electric heating equipment in different parts of the country and in various types of buildings, and a report on the future of the industry.

The Exposition is open only to representatives of the trade. Stanley B. Aronson, head of the Section's Publicity Committee, is general chairman of the event. He is sales manager of Berko Electric Mfg. Corp., Queens Village, N. Y. C. F. Kreiser, general sales manager, Edwin L. Wiegand Co., Pittsburgh, Pa., is chairman of the Section.

PVC ROYALOK

Caps and Connectors interlock with a twist of the wrist . . . give you rugged, positive, fail-proof power connections.

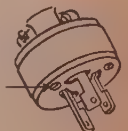
Unbreakable molded vinyl bodies—can't crack, chip, or break . . . hold blades and contacts solidly in place. Resistant to acid, oil, and grease.

Safer, stronger construction—Dead-front caps eliminate nuisance of fiber washers and dangers of exposed conductors. Internal barriers separate conductors. One-piece connectors have heavy brass double-wipe contacts locked in solid vinyl.

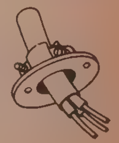
ORDER FROM YOUR WHOLESALER, OR WRITE FOR CATALOG 2-58-4.

QUICK, CLEAN WIRING 3 Simple Steps!

❶ Remove cord grip plate by loosening plate screws (they can't fall out).



❷ Insert cord thru clamp, strip conductors and connect to terminals.



❸ Replace grip plate, tighten screws — that's all!

A Broad Line of ROYALOK Interlocking* Devices

2-Wire Polarized 10 Amp — 250V 15 Amp — 125V 20 Amp — 250V Dead-front caps . . . one-piece connectors	*3-Wire Polarized Grounded* 10 Amp — 250V 15 Amp — 125V 20 Amp — 250V 10 Amp — 600V Dead-front caps . . . one-piece connectors	*4-Wire Grounded* 20 Amp — 250V 10 Amp — 600V Dead-front caps . . . one-piece connectors

*Fit all standard interlocking devices

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ROYAL ELECTRIC CORPORATION
PAWTUCKET, RHODE ISLAND

BLACKHAWK INDUSTRIES SNAP STRAP

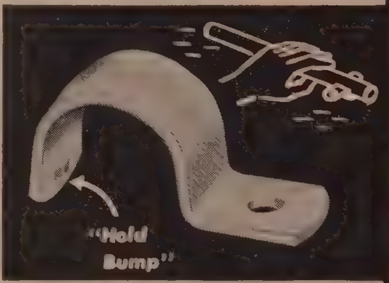
the original snap-on clamp

SNAPS TIGHTER, HOLDS ITS GRIP

easier to sell because it's easier to use

WHY it's better—The B-I SNAP STRAP has the "hold bump" at the open end of the bracket—really grips—resists slips like an alligator wrench! Ribbed bracket adds to the snap, provides rigid contact support of the conduit!

SPEEDS WORK . . . MORE JOBS, MORE PROFITS—Faster installations mean more profit for installers and their suppliers. The SNAP STRAP *means* faster installations . . . eliminates time-wasting fumbling, dropping, annoyance—all the *temper* is in the SNAP STRAP. Made of heavy gauge steel, zinc plated after fabrication. Wide range of sizes for rigid and thin-wall conduit.



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BLACKHAWK INDUSTRIES
DUBUQUE, IOWA

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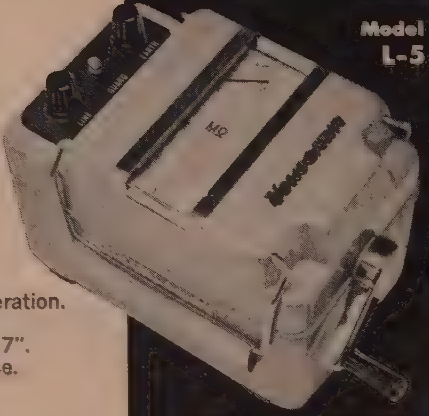
MAXIMUM PORTABILITY

SELF-SHIELDED INDICATOR
(Core Magnet System)

RANGES:
100V/20 megohms to
1000V/2000 megohms.

FEATURES:
Nylon gear, smooth silent operation.
Direct reading in seconds.
Weighs only 5 lbs., less than 7".
Housed in gray aluminum case.

Model
L-5



carrying case and
leads optional

APPLICATIONS
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- Switches
- Capacitors
- Circuit Breakers, etc.

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40 Worth Street • New York 13, N. Y.

Wiring Conference Hears Sales Plans

National programs currently backing sales of residential and commercial wiring and outstanding local and individual promotions were critically reviewed by a top level conference of industry leaders in wiring sales activity at the annual National Wiring Conference held on February 25-26 at the Warwick Hotel in Philadelphia. Registration for the record meeting exceeded 500.

Milton I. Allen, vice president in charge of sales, Philadelphia Electric Co., representing the Edison Electric Institute, gave the keynote address stressing the importance of broad industry cooperation to bring the full benefits of modern electric living to the public.

A novel "public hearing" found Ralph Zenthen, manager, Live Better Electrically Program, EEI, Laurance Messick, director, Medallion Home Program, NEMA, and Frances Armin, director, Residential Program, National Wiring Bureau, as the "witnesses" to a detailed "interrogation" on the operations of the three major residential electrical promotion programs.

The presentation brought out the new alignments and relationships of the 1960 programs. Live Better Electrically, under EEI, carries on the major national advertising programs. The Medallion Home Program is now administered by NEMA which will maintain the national headquarters for custodianship of the Medallion and responsibility for issuance of authorization for its use in local programs. The National Wiring Bureau, under NEMA, administers the Housepower Program. However, all three programs are operated in close coordination.

The new "Keep Pace Electrically" program, the commercial counterpart of "Live Better Electrically," was explained by Andrew Corman of the National Wiring Bureau. The initial advertising appeared during National Electrical Week, paid for by NECA as one of NWB's sponsors. A following advertising program by NWB will run 122 times in 19 business and commercial publications. In addition, promotional materials will be available to utilities and electrical contractors for local and regional use.

The Housepower Profit Clinic, an intensive contractor sales training program, was described by John T. Catherwood, coordinator of dealer promotion and planning, Long Island Lighting Co., Mineola, N. Y. The clinics are prepared by a professional training agency, the Porter Henry Co., for EEI and are made available to utility companies for local use. The profit clinic explores modern management practices, business controls, estimating, pricing, and sales methods.

F. E. Keith, Keith Electric Co., Des Moines, Iowa and chairman of the marketing committee of NECA, explained the Contractor Development Program being conducted by the Association. The program deals primarily with the management aspects of the electrical contracting business. It sets forth the management considerations that go into policy determinations as to the markets to be served and how to serve them best. The heart of the program is a self-analysis chart to help the contractor follow the yardsticks of management and apply them to his own operation. Trained work-shop directors will meet with groups of electric contractors to assist them in applying the self-analysis criteria.

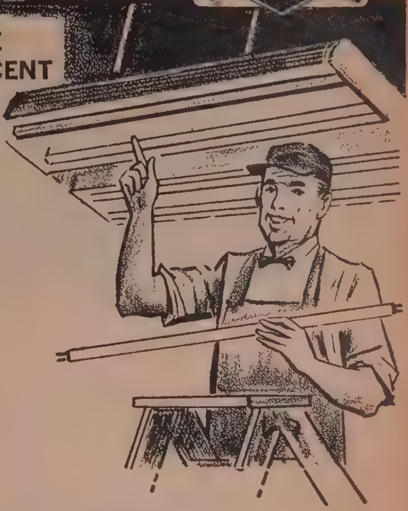
The contractor, he said, has long been the victim of a system that tends to minimize his sales effectiveness—the practice of competitive bidding—especially where the customer is not a skilled buyer of construction services and cannot accurately determine that he is getting performance, as is usually the case with smaller jobs. There is a point beyond which competitive bidding is not an economical method, and practically all small work in the electrical modernization field falls well below that point. Competition would be on a selling basis—creative selling—in the customer's interest-negotiation instead of formal bidding. In small work the ability to render service, engineering service, though on a small scale, is more important to the customer than a few dollars in price.

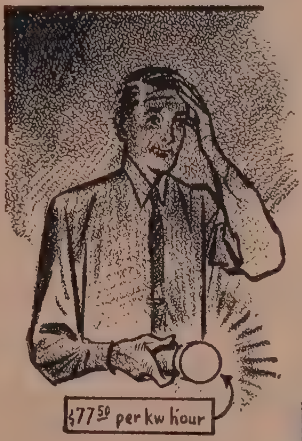
Among the several local promotional activities presented to the conference, J. D. Hampton, supervisor of adequate wiring promotion, Oklahoma Gas and Electric Co., Oklahoma City, Okla., discussed the progress of his company from certified wiring through the Medallion Home. In 1957 they modified their earlier program to combine Housepower with major appliances. They found that they could frequently sell built in appliances and associated wiring in the same total time as had been required for a wiring sale alone. They saw the possibilities of the Medallion Home Pro-

Facts of Light! CHAMPION Lamps

SOMETIMES IT COSTS MORE TO OPERATE ONE FLUORESCENT THAN TO OPERATE TWO

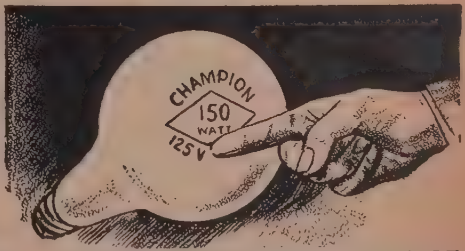
When only one fluorescent lamp is operating on a lead-lag ballast designed to handle two lamps, more line current can be drawn than if both lamps were operating. This is due to a shift in power factor. Moral: keep all lamps operating — you can draw less current and get twice the light.





IT COSTS $77.50 per KW hour to RUN A FLASHLIGHT

When a lamp is run on a flashlight battery the power cost is in the vicinity of $77.50 per KW hour. The power cost to operate lamps from residential electric supply is only 2.66 cents per KW hour.



A LITTLE VARIATION IN VOLTAGE CAN MEAN A LOT IN THE LIFE OF A LAMP

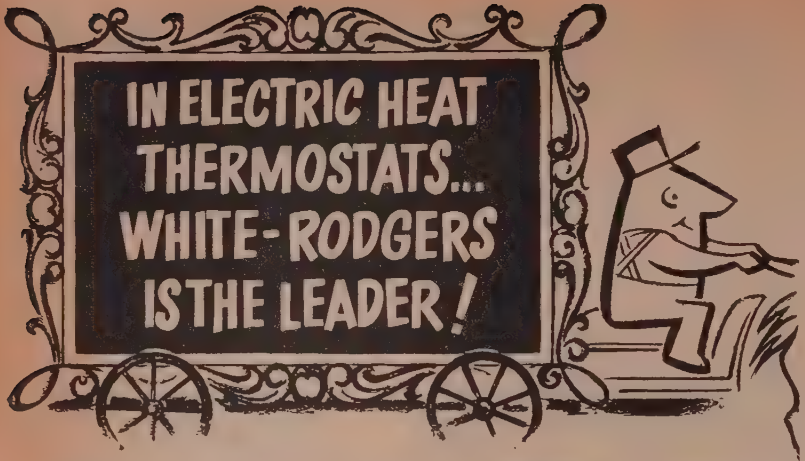
Incandescent lamps are designed to yield maximum lighting economy when used on circuits where the voltage is the same as that printed on the bulb. When the circuit voltage is 5 volts above the bulb rating lamp life can be cut in half. A variation of 5 volts below rating can double lamp life.

YOUR NEW CHAMPION LAMP HAS ALREADY BEEN LIGHTED AT LEAST 7 TIMES

Every Champion lamp is lighted a minimum of 7 times before it is packaged. Checks like this are typical of the strict quality control maintained at Champion and one of the reasons why the Champion Diamond on the outside of a lamp means a dependable source of light on the inside.

CHAMPION LAMP WORKS, Lynn, Massachusetts

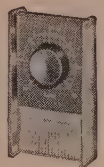
CHAMPION INCANDESCENT-FLUORESCENT • *YOUR BEST BUY IN LAMPS*


IN ELECTRIC HEAT
THERMOSTATS...
WHITE-RODGERS
IS THE LEADER!

Use them with confidence—they're specifically designed for Electric Heat by White-Rodgers—world's largest maker.

Sold under the brand names of more than fifty manufacturers of quality electric heating equipment.

Type 1A61
World's Largest Seller

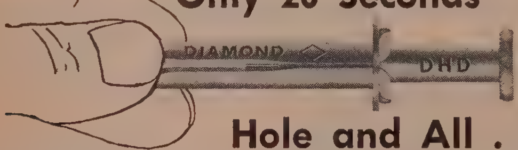


Type 1A65
Elegant New Companion

Write for full color folder R 1625

WHITE-RODGERS CO., ST. LOUIS 6, MISSOURI TORONTO 8, CANADA

"Only 20 Seconds*



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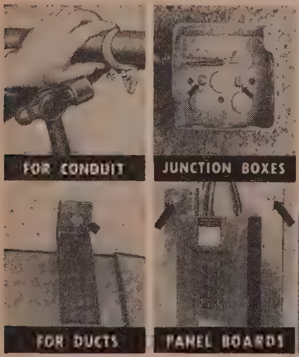
is all it takes to ANCHOR into BRICK or CONCRETE with DHD® Hammer Drive Anchors. They are SAFE, fast and secure. The smallest size holds 500 to 700 lbs. For use indoors or outdoors. Sizes available from*3/16" x 7/8" to 1/2" x 3-1/2". Would you like to try a few samples, free? Just fill in the coupon below."



JOHN A. WRIGHT Vice President

WHERE TO BUY DHD® ONLY thru your distributor, whose stocks of all Diamond Anchors enable you to get fast delivery service. This policy plays an important part in your ability to get contracts done faster and profitably.

BRANCHES:
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Diamond Expansion Bolt Co.
Garwood, N. J., U.S.A.
Please send me samples of your DHD Hammer Drive Anchors

Name__________
Concern__________
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City__________ State__________

gram when it was first presented and adopted both the Gold Medallion and Bronze Medallion plans.

Mr. Hampton showed a series of sales aids and local advertising devices used for Medallion Home promotion. Builder signs, 22 in. by 30 in., were located in the front windows of houses under construction. Easel mounted certificates were designed for easy placement.

A Sunday newspaper ad ran individual listings of Medallion homes with builders sharing the cost. After the first few insertions, there was a waiting list of builders who wanted to be listed. Newspaper ads also tied in with special home shows. Lighted billboards, 10 ft by 20 ft, were used in strategic spots in new developments where 20 or more Medallion homes were under construction.

In 1959, 518 homes received medallions—45 of these the all-electric Gold Medallion. About 1200 Medallion Homes are expected to be built in 1960. Five all-electric apartment developments with 114 living units were sold in 1959, and 210 more are in the design stage.

Barry M. Dietrick, vice president of Frame Electric Co. electrical contractors of Pittsburgh, Pa., recited some of his company's experiences demonstrating how modernized wiring benefits office building owners. He emphasized that owners do not want the details of how their systems can be modernized but do want the benefits. He pointed out that building modernization is usually a program starting with some one symptom of impending trouble and developing from there.

A long-range complete modernization program, he continued, is the only deal any thinking building owner should accept—one of planned steps in chronological order—what he needs right now—and assurance that parts deferred until later will build effectively on the initial phase to ultimately produce a modern wiring system.

The sixth anual *Look* magazine awards for outstanding residential wiring gave top honors to three utilities; Niagara Mohawk Power Co., Syracuse, N. Y.; Virginia Electric & Power Co., Richmond, Va.; Dayton Power & Light Co., Dayton, Ohio; the North Central Electrical League, Minneapolis, Minn.; the Noland Co., Newport News, Va., electrical distributors and R. C. Electric, Milwaukee, Wis., electrical contractors. Tony Muska Electric Co., electrical contractors of St. Paul, Minn., also received an honorable mention award.

John Frommer Elected President of NYECA

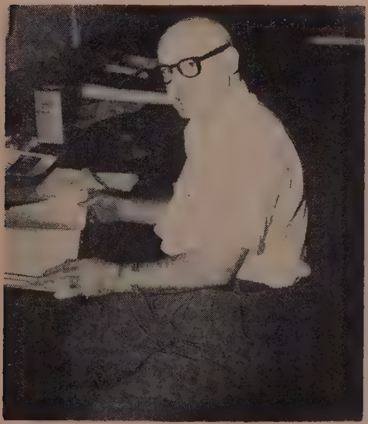
At the anual meeting of the New York Electrical Contractors Association, Inc., John W. Frommer was elected president. Other officers elected were: J. M. Watters, Jr., vice president; Stephen C. Reville, treasurer, and Benjamin Bierman, secretary.

E. A. Kahn was named representative on the Board of Governors of the NECA. Committee Chairmen are Egbert L. Heine, Membership; J. W. Werther, Legislative; John P. Morrissey, Constitution and By-Laws; John Doris, Trade Jurisdictional.

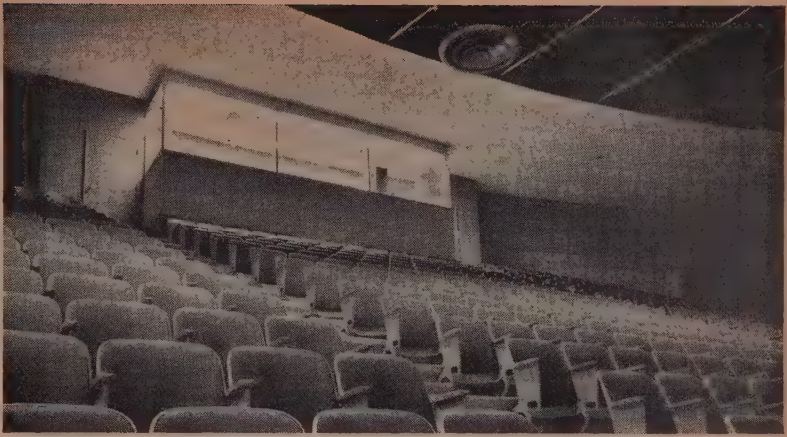
NECA Rocky Mountain Chapter Officers

C. Armstrong of Wazee Electric Co., has been elected 1960 president of the Rocky Mountain Chapter of the National Electrical Contractors Assn.

The new vice president is Ernest C. Graham of Belmont Electric Co. Steve Strong of Scott Bros. Electric Co. was chosen secretary, and Roy Kennedy of Kennedy Electric Co., treasurer. Harris Steele of Reliable Electric Co. was elected representative on the national board of governors. Ed Kummer was chosen Boulder, Colo., division chairman; Frank Kading, Casper, Wyo., division; and W. G. Dale, Cheyenne, Wyo., division.



BILL REYNOLDS is general foreman for Fischbach and Moore, Inc., electrical contractors with L. K. Comstock and Company on the installation in the new Chase-Manhattan Bank building, New York City. The job is a pioneering application of feeders in aluminum conduits in all sizes from 1½-in. up, a total of over 125,000 ft of conduit.



ALL THIS
AND STEREO, TOO!

from Stromberg-Carlson, communication specialists

The choice of a Stromberg-Carlson sound reinforcement system for the new Memorial Auditorium in Utica, New York, assures complete coverage of the entire building—and much more.

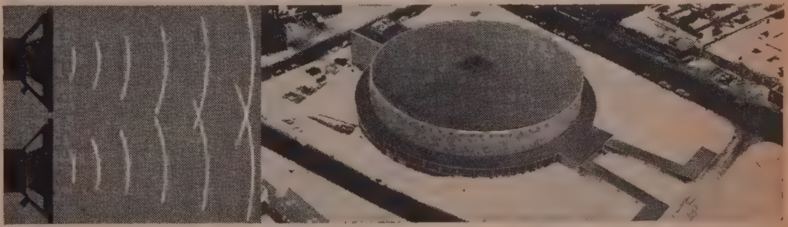
The system is wired for stereophonic sound, bringing to audiences the full, realistic richness of sound in three dimensions. The system is versatile enough to provide any kind of programming and sound distribution, including tape, records, and broadcast material. Strategic placement of wide-range speaker systems assures precisely the right kind of reinforcement for any event. A separate paging system provides coverage throughout the building.

All these custom features are built into a system custom-engineered of *standard* Stromberg-Carlson components. And this flexible, economical arrangement is available to meet the needs of *your* customers in new or existing construction.

More and more contractors are swinging to Stromberg-Carlson sound and communications equipment because they have learned that the assistance and service rendered by Stromberg-Carlson sound distributors make installation easier and require fewer contractor man-hours.

When you bid Stromberg-Carlson, you bid competitively—with assurance of a good profit and an installation that will add to your prestige.

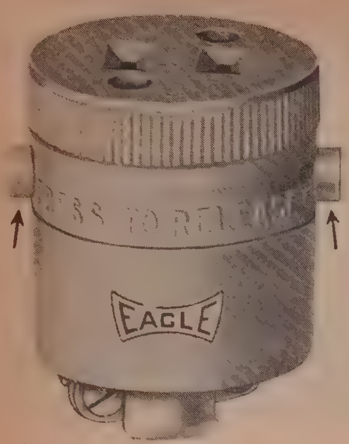
For further details, or the name of our local representative, write to Special Products Division, 1453-03 North Goodman Street, Rochester 3, New York.



Among the unusual custom features of the Stromberg-Carlson sound reinforcement system in the Utica (New York) Memorial Auditorium is stereophonic sound reproduction. Electrical contractor: Langdon & Hughes Construction Corporation of Utica.

"There is nothing finer than a Stromberg-Carlson"

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS



ANOTHER EAGLE® EXCLUSIVE

CUTS
MAINTENANCE COSTS
SAVES TIME
AND MONEY
THE ONE AND ONLY
LOCK-ON CONNECTOR

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U. S. PAT. 2,732,531
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NOW you can use one LOCK-ON Rubber Cord Connector to replace two locking devices. The LOCK-ON automatically locks any standard cap, eliminates power interruptions. Cap is released only when both buttons are pressed. U.L. approved. Specify EAGLE No. 50 on your next order.

SOLD THRU WHOLESALERS

EAGLE ELECTRIC MFG. CO., INC.
LONG ISLAND CITY 1, NEW YORK
"PERFECTION IS NOT AN ACCIDENT"

ALL OVER THE U.S.

Sun-Tron ELECTRIC HEAT

Design of Distinction

now heating many types of buildings:

- *Ranch Homes*
- *Split-Level Homes*
- *Two-Story Homes*
- *Apartment Buildings*
- *Room Additions*
- *Offices*
- *Institutions*
- *Motels*

Hospital Dormitory for Nurses (under construction)

Ranch House Room Addition

Radiant Wall and Baseboard Panels with "A Size for Every Room". Available in 6 convenient sizes: 48x6, 30x9, 36x9, 36x14, 72x9, 36x18. Your choice of: oak, mahogany-walnut, beige-tone, pearlized grey finishes.

APPLICATION ENGINEERING AVAILABLE
To assist builders, electrical contractors and others in incorporating Sun-Tron Electric Heat into their buildings, Sun Tron maintains an application engineering department. Submit detailed construction specifications, floor plans and elevations for estimate and proposal.

- Distinctive Styling
- Greater Efficiency
- More Durable Construction
- Most Convenient Utilization
- Simplicity of Installation
- Ultimate in Comfort

Sun-Tron CORPORATION

Write For Free Analysis Booklet

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1st Nat'l Electric Heating Exposition
Sherman Hotel
March 21-23
Booth #262 & #263

ANDERSON ELECTRIC Superintendent Oliver Stump checks coding of local panel circuiting with foreman John Anderson during wiring of recently completed Logan Building in Seattle, Wash.

New Books

Electrical and Electronic Drawing, by Charles J. Baer; 218 pages, $6.00. McGraw-Hill Book Co., 327 W. 41st., New York 36, N. Y.

An up-to-date picture of the entire electrical drawing field, including the latest symbology and practice. The book covers the preparation of pictorial drawings, connections drawings and diagrams, block diagrams, and schematic. Standard engineering, production, or working drawings are included where specific examples of this type deserve special mention.

The Heating Ventilating Air Conditioning Guide, 1959, 37th edition. 768 pages of technical data; 461 pages of catalog data. $12.00. American Society of Heating Refrigerating and Air-Conditioning Engineers, 62 Worth St., New York 13, N. Y.

In addition to the categories covered in previous editions on heating and cooling loads, room heating and cooling methods and equipment, controls, instruments and motors, etc., five new chapters have been added on the heat pump, snow melting, high temperature water systems, evaporative air cooling and humidification. Valuable for electric heating installation are chapters on electric heating, heat transmission coefficients of building materials, moisture in building construction, and heating load. New format and large page size has made it possible to include more useful data. For example, typical calculations accompany each table of heat-loss factors to indicate method used to obtain values.

Inspection Manual, edited by Horatio Bond. 320 pages; $4.00. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

A new guide to check and improve the safety of property from fire, this manual includes inspection procedure, what to look for in various occupancies, heating hazards, inspection of protective equipment, what "approvals" mean, and how to make plans and reports. Electrical section lists related codes and standards and discusses common faults found in inspection of electrical systems and static control.

Compilation of Standards on Electrical Insulating Materials; 792 pages, $8.75. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

This edition contains 108 standards of which 46 are new, revised or have had their status changed since the previous edition in 1957. Among topics covered are insulating shellac and varnish; magnet wire insulation; flexible sheet, tape and tubing; plates, sheets, tubes and rods; insulating papers; mica products; encapsulating and embedding compounds; electrical tests; plastics for electrical insulation; and rubber tape and electrical protective equipment.

Rural Electrification in the United States; 48 pages; single copy free, additional copies 90 cents. Edison Electrical Institute, 750 Third Ave., New York 17, N. Y.

This booklet traces rural elec-

H. L. MICHENER, asst. manager of engineering, NEMA, is the author of NEMA's "Analysis of 1959 Revision of NEC" which was distributed to all delegates attending the Eastern Section IAEI meeting. L. D. Price (right), manager, Engineering and Safety Regulations Dept., NEMA, attended the meeting as an observer for NEMA committees.

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trification's progress and how years of research, development, and promotional efforts by the nation's investor-owned electric power companies contributed to it. Covered is the coming of electricity to the farm and the challenge presented to the electrical industry by today's mechanization.

Electrical Efficiency in Industrial Power Plants, by Edwin S. Lincoln; 235 pages; $9.50. F. W. Dodge Corp., 119 W. 40th St., New York 18, N. Y.

A practical engineering guide to lower power costs, telling exactly how to make surveys of load, power factor, voltage, lighting, wiring, and electrical protection. All necessary instruments are discussed in detail, with emphasis on their selection, continued use, and maintenance. Particular attention is paid to methods of lowering rates by minimizing peak demands.

Recommendations for the Dimensions and Output Ratings of Electric Motors, Part 1. $2.40. American Standards Association, Dept. PR 117, 70 E. 45th St., New York 17, N. Y.

A complete discussion of foot-mounted ac induction motors with shaft heights between 56 and 315 millimeters, for voltages up to 600 volts and for frequencies of 50 and 60 cps, including tables of standard dimensions, shaft extensions, and output ratings.

Methods for Inspection of Standing Wood Poles in Overhead Lines; 20 pages; 50¢. Edison Electric Institute, 750 Third Ave., New York 17, N. Y.

This booklet presents specification data on all types of wood poles, discussing in detail such subjects as causes of pole failure; pole inspection crews; tools and equipment; records; methods of evaluating pole condition; interpretation of pole brand symbols; and scheduling of inspections. An appendix gives samples of record forms and an example of method used for calculating pole strength during inspection.

Fundamentals of Electricity, by Kennard C. Graham; 342 pages, $4.75. American Technical Society, 848 E. 58th St., Chicago 37, Ill.

Beginning with the nature of electricity and following with a detailed treatment of circuits, circuit elements and basic electrical machinery, this book provides a solid foundation in electrical fundamentals. New material on intercom systems, television transmitters and camera tubes, radar, and devices used in automation bring the reader up to date in modern applications of electricity.

Modern Schools Are Heated Electrically; EEI Publication 59-214, 20 pages, $1.25. Sales Div., Edison Electric Institute, 750 Third Ave., New York 17, N. Y.

Prefaced by a section outlining the advantages of electric heat in schools, this report lists 212 schools in 29 states which have installed electric heat. Data include number of classrooms and other rooms, connected heating load, type of heating equipment, degree days, and date of installation for each school.

ENGINEER-ESTIMATOR Jack Adams spends most of his day at the "board" and is an important member of the F. D. Hayes Electric Company of Lansing, Mich. Walls of estimating room where Jack carries on his work are covered with peg-board material which permits a variety of arrangements for shelving holding catalogs and reference books.

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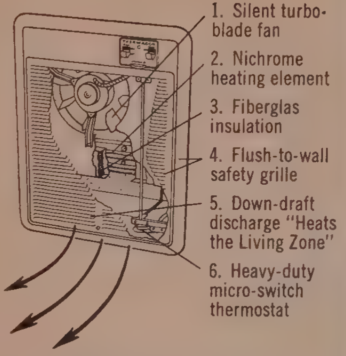
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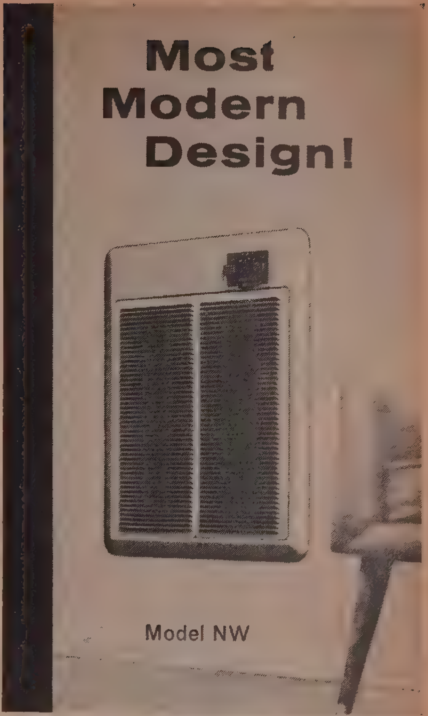

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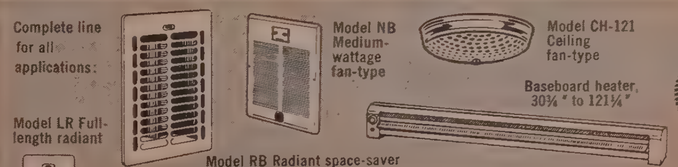
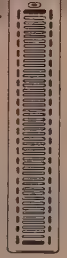

Model NB Medium-wattage fan-type
Model CH-121 Ceiling fan-type
Baseboard heater, 30¾″ to 121¼″
Model LR Full-length radiant
Model RB Radiant space-saver



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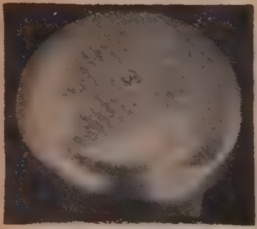
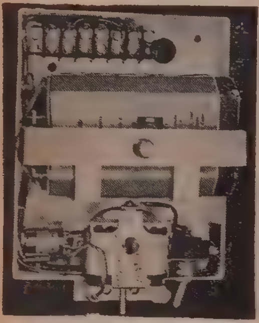


Photo showing 8 in. bell of LIFE SAVER SR. MODEL C1



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DATES AHEAD

NISA Chapter Meetings—Southwestern, Dallas, Texas, March 10-12; **New York**, March 17; **New England-Connecticut**, Springfield, Mass., March 19; **Midwestern**, Sioux City, Iowa, March 26; **New England**, Boston, Mass., April 14; **Great Lakes**, Detroit, Mich., April 18; **North Central**, Minneapolis, Minn., April 22; **King Coal**, Kentucky Lake, Ky., April 27; **Southwestern**, Austin, Texas, September 22-24.

International Association of Electrical Inspectors—Chapter Meeting—Missouri-Kansas, Springfield, Mo., March 17-18; **Mississippi**, King Edward Hotel, Jackson, Miss., March 28-29; **Virginia**, Mariner Hotel, North Virginia Beach, Va., April 4-5; **Ellis Cannady**, Carolina Hotel, Raleigh, N. C., April 12-13; **Alabama**, Admiral Semmes Hotel, Mobile, Ala., April 25-26; **Tennessee**, Andrew Jackson Hotel, Nashville, Tenn., May 2-3; **Florida**, George Washington Hotel, West Palm Beach, Fla., May 5-7; Joint five chapter meeting **North Louisiana-East Texas, Baton Rouge, George Welman, Texas Gulf Coast**, Hotel Marshall, Marshall, Texas, May 6-7; **Georgia-South Carolina** joint meeting, DeSoto Hotel, Savannah, Ga., May 9-10.

1st National House Heating Exposition Electrical House Heating Equipment Section, National Electrical Manufacturers Assn., Sherman Hotel, Chicago, Ill., March 21-23.

Electrical Maintenance Engineers Assn. of California—10th Biennial Electrical industry show, Shrine Exposition Hall, Los Angeles, Calif., March 23-26.

American Power Conference—Sherman Hotel, Chicago, Ill., March 29-31.

Electrical Living Show, Milwaukee Home Show—Milwaukee Arena, Milwaukee, Wis., April 2-10.

Edison Electric Institute—Sales Conference, Edgewater Beach Hotel, Chicago, Ill., April 4-6.

1960 Electrical Show for Industry—Cleveland Public Hall, Cleveland, Ohio, April 5-7.

Illuminating Engineering Society—Regional Conferences: **South Central and Southeastern**, Peabody Hotel, Memphis, Tenn., April 22-23; **Southwestern**, Robert Driscoll Hotel, Corpus Christi, Texas, April 25-26; **Inter-Mountain**, Mountain Shadows Resort, Scottsdale, Ariz., April 28-29; **South Pacific Coast**, Ambassador Hotel, Los Angeles, Calif., May 4-6; **Pacific Northwest**, Benjamin Franklin Hotel, Seattle, Wash., May 9-10; **Midwestern**, Sheraton-Martin Hotel, Sioux City, Iowa, May 12-13; **Great Lakes**, Carter Hotel, Cleveland, Ohio, May 16-17; **Northeastern**, Wentworth-By-The-Sea, Portsmouth, N. H., June 8-9; **Canadian**, Nova Scotian Hotel, Halifax, N. S., June 13-14.

Maintenance and Plant Engineering Conference—Chase-Park Plaza, St. Louis, Mo., April 25-26.

Western Air Conditioning Show—Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Shrine Exposition Hall, Los Angeles, Calif., April 27-30.

National Association of Electrical Distributors—Annual convention, Dallas, Texas, May 1-5.

National Industrial Service Assn., Inc.—Annual convention, Hotel Fontainebleau, Miami Beach, Fla., May 8-11.

National Fire Protection Assn.—Annual meeting, Montreal, Canada, May 16-20.

Pacific Coast Electrical Assn.—Annual convention, Stardust Hotel, Las Vegas, Nev., May 16-18.

Design Engineering Conference and Show—Statler-Hilton and Coliseum. New York, N. Y., May 23-26.

Construction Caribbean—A building materials show, San Juan, Puerto Rico, June 3-9.

Edison Electric Institute—Annual Convention, Atlantic City, N. J., June 6-8.

New York State Association of Electrical Contractors & Dealers—61st annual convention, Whiteface Inn, Lake Placid, N. Y., July 3-8.

National Association of Lighting Maintenance Contractors—National conference, Milwaukee Inn, Milwaukee, Wis., August 22-24.

Illuminating Engineering Society—National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., September 11-16.

International Association of Electrical Inspectors — Northwest Section, Sheraton-Portland Hotel, Portland, Ore., September 12-14; **Southwest Section**, Mapes Hotel, Reno, Nev., September 19-21; **Eastern Section**, September 26-28; **Western Section**, Continental Hotel, Kansas City, Mo., October 3-5; **Canadian Section**, Toronto, Ont., Canada, October 8-9; **Southern Section**, Rice Hotel, Houston, Texas, October 17-19.

Pennsylvania Electric Assn.—53rd annual meeting, Penn-Sheraton, Pittsburgh, Pa., September 20-22.

International Association of Electrical Leagues—25th annual conference, Hotel President, Kansas City, Mo., October 5-7.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 10-12.

Florida Association of Electrical Contractors—Annual Convention and 8th Electrical Trade Show, Deauville Hotel, Miami Beach, Fla., October 12-15.

National Electrical Contractors Association—1960 annual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif, November 25-30.

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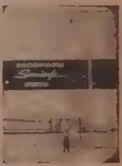

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Among the Manufacturers

Headquarters Announcements

William Brand & Co., Willimantic, Conn., and **The Rex Corp.**, West Acton, Mass., have been consolidated into the William Brand-Rex Div. of American Enka Corp.

National Supply Co., Pittsburgh, has licensed Pioneer Electric Eastern, Ltd., Toronto, Canada, to manufacture Spang underfloor duct and Headerduct.

Pittsburgh Reflector Co., Irwin, Pa.—Harold Siler and John S. Frizzell, vice presidents.

Wheatland Electric Products Co., Pittsburgh, Pa., and Wheatland Metal Mfg. Co., subsidiary—R. C. Bennett, Jr., president; J. L. Bauer, manager of conduit sales and service; T. E. Hoskins, chief product engineer.

Duro Sales Co., Los Angeles, Calif.—Luther D. Shank, director of marketing.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—Dr. Jay Tol Thomas, director of engineering, Boston Div.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Paul W. Clark, manager of sales; William E. Korsan, assistant manager—Industrial Systems Dept.

Ridge Tool Co., Elyria, Ohio—W. C. Parcell, executive vice president.

S&C Electric Co., Chicago, Ill.—C. C. Martin, director.

Litecraft Mfg. Corp., Passaic, N. J.—Michael Lechner, director of manufacturing, Passaic plant.

International Rectifier Corp., El Segundo, Calif.—W. H. Atkinson, marketing manager.

Richardson-Allen Corp., College Point, N. Y.—Columbus O'Donnell, president.

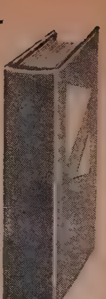
Western Insulated Wire Co., Los Angeles, Calif.—Richard O. Pallin, assistant sales manager.

Wagner Electric Corp., St. Louis, Mo.—Harold N. Felton, vice president, marketing, and director; Carl E. Widell, assistant vice president, marketing; Ralph W. Boeringer, vice president, industrial relations; Harold S. Garrett, director of purchases.

Graybar Electric Co., Inc., New York—Edwin Lex Bacon, general advertising and sales promotion manager; Raymond C. Babcock, advertising manager; Ralph Sackett, Jr., sales promotion manager.

Ramco Mfg. and Engineering, Portland, Ore.—J. Walter Nelson,

CONNECTING INDUCTION MOTORS
Operation and Practice



Just Published—Fourth Edition. Practical manual helps get better results in changing, winding, and connecting induction motors to meet any condition of voltage, phase, frequency, or speed. Covers everything from fundamentals of how induction motors work to work methods, useful diagrams and tables, trouble shooting pointers, etc. Fourth edition contains four added chapters, standardized terminal identifications, and other new helps. **By A. M. Dudley; and S. F. Henderson, Westinghouse Electric Corp. 4th Ed., 432 pp., 430 illus., $13.50**

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HOME WIRING MANUAL

This practical manual tells how to analyze the electrical requirements of various types of applications and plan adequate systems for them. Fully explains equipment, appliances, lighting, loads, service entrance feeder size, branch circuits, electric outlets, and other factors in planning for easy installation and effective service. Also covers usage of electricity on the farm, including procedures for planning systems of outside electrical distribution. **By A. Carl Bredahl, Formerly Technical Services Director, Westinghouse Electric Corp. 221 pp., 97 illus., 38 tables, $4.95**

ELECTRICAL ESTIMATING

Here is the information you need to estimate the cost of any electrical construction job quickly and accurately. This book helps you prepare final bid sheets, determine operating costs, and prepare mark-ups in accord with rendered services. It also covers lighting and power branch wiring; distribution equipment; auxiliary, summary, and final bid sheets; estimating work of other trades; special projects; and residential wiring. Time studies and preparation of labor cost units as well as studying plans and specifications are examined in detail. **By Ray Ashley, Consulting Editor, *Electrical Construction and Maintenance*, 2nd Ed., 363 pp., 208 illus., charts, and tables, $9.50**

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Cornell-Dubilier Electric Corp., South Plainfield, N. J.—J. Albert Bertolacci, treasurer.

Snap-on Tools Corp., Kenosha, Wis.—Irving Johnson, national equipment sales manager.

Smithcraft Corp., Chelsea, Mass.—George T. Wood, vice president, marketing; Park R. Hoyt, vice president, manufacturing.

Marcus Transformer Co., Rahway, N. J.—Bernard H. Anderson, vice president.

Guardian Light Co., Oak Park, Ill.—Walter H. Beigel, national sales manager, service station and outdoor advertising lighting.

Edwards Co., Inc., Norwalk, Conn.—R. S. Edwards, Jr., sales manager.

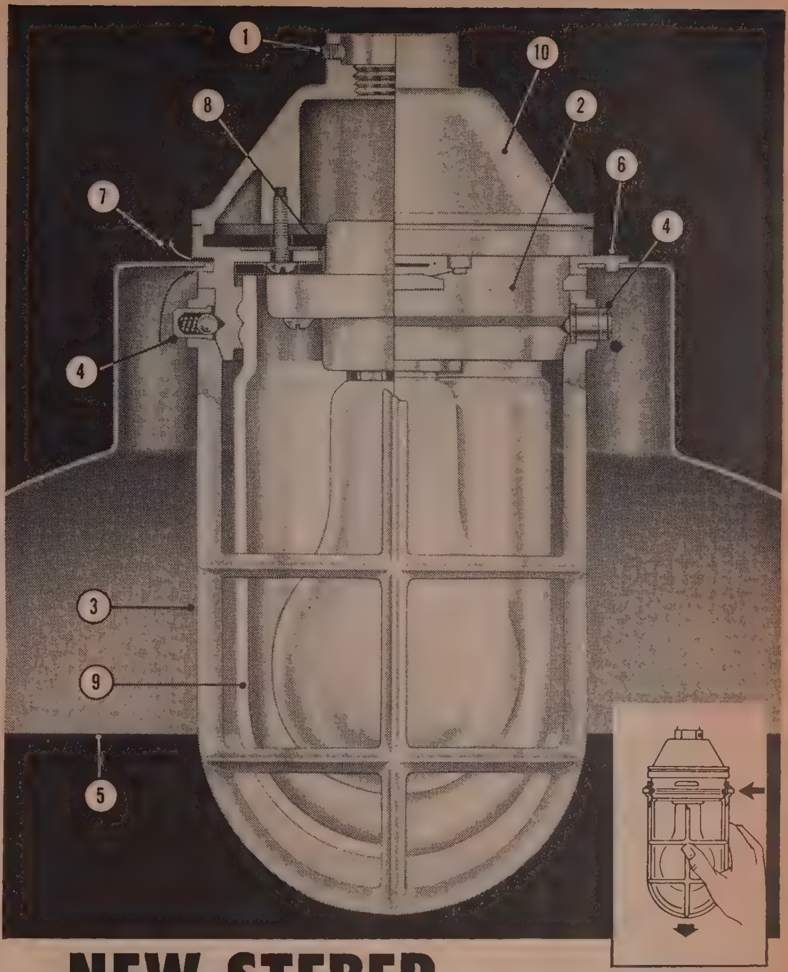
National Electric Div., H. K. Porter Co., Inc., Pittsburgh, Pa.—Charles J. Philage, advertising manager.

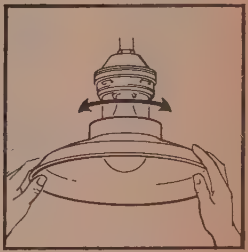
Halo Lighting Products Inc., Chicago, Ill.—Robert S. Fremont, president; Frederic G. Gordon, secretary-treasurer.

Pennsylvania Transformer Div., McGraw-Edison Co., Canonsburg, Pa.—William I. May, manager, small power transformer sales.

John C. Virden Co,, Cleveland, Ohio—William C. Giesse, sales promotion manager; John J. Gutwald, chief industrial engineer.

A NEW SECTION of the Illuminating Engineering Society received official sanction when Regional Vice President James E. Barnes (at mike) presented charter and gavel of office to the Diablo Section's first chairman, Grant Radford, at a November dinner meeting held in Oakland, Calif.





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4. Stainless Steel Ball Detents—permit attachment and removal of guard without aid of tools.
5. White Porcelain Enameled Reflector—Standard Dome, Shallow, Deep Bowl or 30° Angle.
6. Nylon shoes—allow reflector to be attached to fixture body by 45° turn—no tools needed.
7. Reflector Ventilating gaps provide chimney action cooling and cleaning.
8. Gasketed construction isolates wiring compartment.
9. Heat-resistant glass globe, clear or choice of four colors.
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Reflectors, removable by a 45° turn without tools for convenient cleaning.

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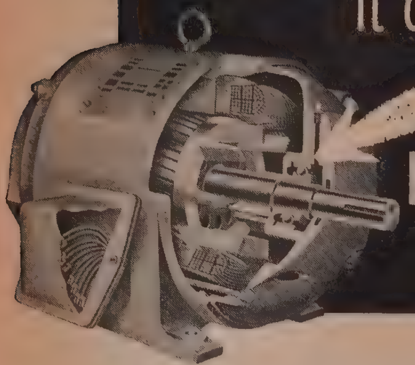

Many motors look practically alike on the outside, but it's what is inside that counts. There is no motor with better windings or more ample bearings—few motors compare favorably. Yet, the Brook Motor costs less, because of volume production, modern techniques, distribution in 76 countries and a realistic pricing policy. Brook Motors have established excellent performance records for over 56 years in every industry using a.c. motors. From 1 to 600 H.P. Send for literature.

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TELEPHONES

They operate in any emergency over a distance of many miles. Can be moved with the job as it progresses or serve permanently. Indoor and outdoor models. Selective ringing, common talking.

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NEW ADVERTISEMENTS

received by March 23rd will appear in the April issue subject to limitations of space available.

Classified Advertising Division
Electrical Construction & Maintenance
P. O. Box 12, New York 36, N. Y.

SELLING OPPORTUNITY AVAILABLE

Representative for distributor of electrical copper wire and cable, to industrials. Established contacts essential. Excellent compensation plan. Full particulars. RW-3818, Electrical Construction & Maintenance. Class. Adv. Div., P.O. Box 12, New York 36, N. Y.

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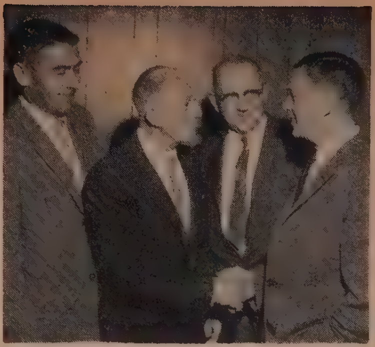


AT A RECENT CONFERENCE of NISA chapter officers in St. Louis, these West Coast shop owners met their national president, Horace C. Blenkhorn (right), of Blenkhorn & Sawle, Ltd., St. Catharines, Ont., Canada. From left: Frank Search, Frank's Electric Motor Service, Long Beach, Calif., Victor J. Hunt, Walker Electric Works, Portland, Ore.; and Harold Patchett, Industrial Electric Co., Everett, Wash.

General Electric Co., Schenectady, N. Y.—Philip R. Milroy, manager of engineering, Outdoor Lighting Dept., Hendersonville, N. C.; David C. Miller, manager, original equipment sales, Miniature Lamp Dept., Cleveland, Ohio.

Regional Appointments

NEW ENGLAND

Century Electric Co.: Gunar Moe, sales manager, Northeast Div.

MIDDLE ATLANTIC

Wheatland Electric Products Co.: J. J. Dougherty, Jr., eastern sales manager.

Silvray Lighting, Inc.: James M. Arthur, regional sales manager, Northeastern Region.

Lightolier Inc.: Gerald Portnoy, representative in southeastern Maryland, Washington, and parts of Pennsylvania.

BullDog Electric Products Div., I-T-E Circuit Breaker Co.: M. L. Martin, manager, Philadelphia district.

SOUTH ATLANTIC

Century Electric Co.: James S. Smith, sales manager, Southeast Div.

General Electric Co.: Henry J. Chanon, manager, Carolinas Sales District, Large Lamp Dept.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: George K. Ommundsen, sales representative covering Virginia, Maryland, and eastern West Virginia.

I-T-E Circuit Breaker Co.: Samuel H. Wilson, manager, new district sales office in Tampa, Fla.

Brown Company: John C. Moore, regional sales manager, southern territory.

Wakefield Co.: Richard Marshall, representative in Charlotte, N. C.; Walter Jerkins, representative in Jacksonville, Fla.

Tork Time Controls, Inc.: Verlyn H. Branham & Son, Atlanta, Ga., southern representative.

Columbia Cable and Electric Corp.: Jim Hash & Co., Knoxville, Tenn., representatives in Tennessee.

EAST CENTRAL

Century Electric Co.: James H. Bolton, sales manager, North Central Div.

Lightolier Inc.: Richard Brayer, representative in Indiana.

Edwards Co., Inc.: A. B. Thomas, central regional manager.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: John H. Roehm, sales representative in southeastern Ohio and West Virginia.

Virden Lighting: Richard J. Fintze, representative in Michigan.

Duray Fluorescent Mfg. Co.: Joseph Olinger & Associates, representatives in Kentucky, Indiana and Illinois.

Wakefield Co.: Dynamic Industrial Sales Co., representatives in Detroit, Mich.

Corning Glass Works: George B. Weinhold, representative in Ohio, Kentucky, and parts of Pennsylvania and West Virginia.

WEST CENTRAL

Century Electric Co.: Fred Powers, sales manager, Southwest Div.; William D. Helm, sales manager, Midwest Div.; George Henderson, general sales manager, Western Div.

Wakefield Co.: Ronald H. Mason, representative in Milwaukee, Wis.; Don Congdon, representative in Denver, Colo.; James Clarke, representative in Columbus, Ohio.

Duro Sales Co.: I. W. Strong, Rocky Mountain representative.

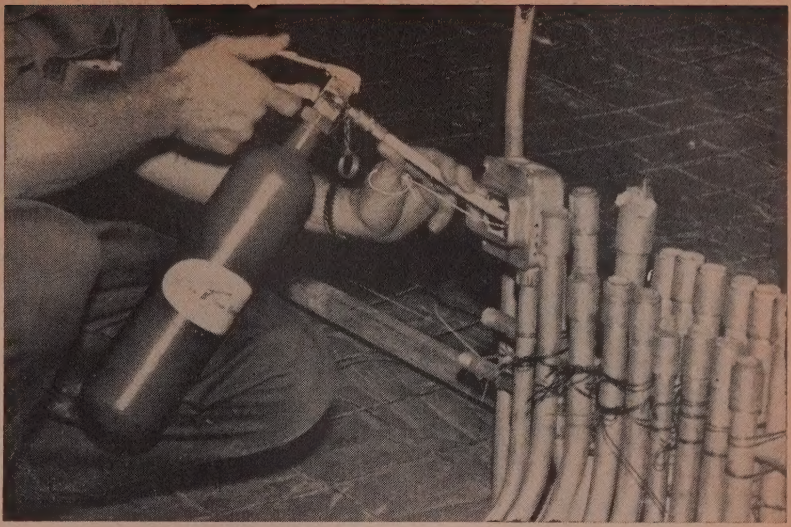
Virden Lighting: John C. Dannemiller, representative in Kansas and western Missouri area.

WEST

Duro Sales Co.: Edward O. Taylor, regional director of sales for Pacific Southwest; Chuck Smith, representative in southern California.

Lightolier Inc.: Daniel Spindler, representative in Los Angeles.

Prescolite Mfg. Corp.: Al Thompson, San Francisco Bay area sales manager.



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eliminates snaking in ½″ and ¾″ conduit!

The new Jet Line Cylinder makes short work of wiring ½″ and ¾″ conduit . . . saves up to 70% of wire-pulling costs . . . can pay for itself on one or two jobs!

Now you can lay a line through one . . . ten . . . even fifty conduits in minutes, regardless of lengths, bends, or loose obstructions! Place a line package in the conduit; secure the free end of the line. Butt the Cylinder seal-off assembly to the end of the conduit and activate the valve . . . pressure, from the expansion of a harmless gas, travels the lightweight line package through the conduit in a split second! The strong nylon line, laid by the package, is used to draw polyethylene rope, then wire, through the conduit in minutes!

The Jet Line Cylinder is safe, no inflammable substances or explosives are used, and nylon line and polyethylene rope are non-conductors.

Kit contains: Cylinder, valve, pressure regulator, valve operating mechanism, and full pressure attachment with variable head. Cylinder refillable; spare cylinders available. Order a Jet Line Cylinder Kit now . . . forget fish tape forever!

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Jet Line Cylinder for ½″ and ¾″ Conduit • Jet Line Gun for Conduit 1″ or larger

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Jet Line Gun Company

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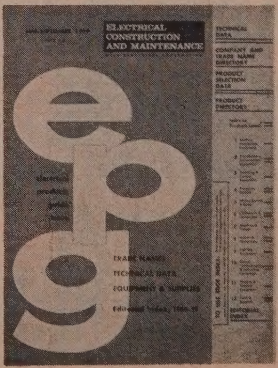


• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

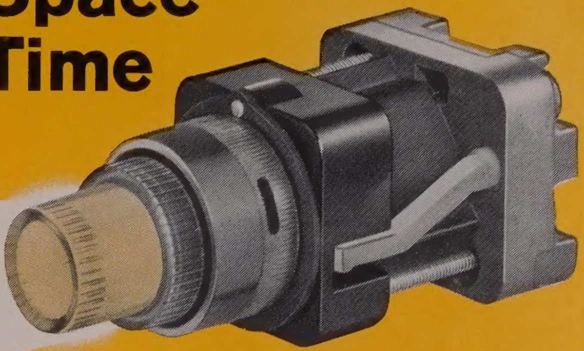
For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

D ...*design leadership*

Save Mounting Space and Installation Time

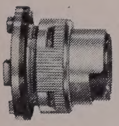
with this...

ILLUMINATED PUSH BUTTON

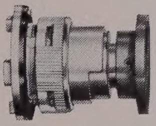


- Push button and pilot light combined in one compact, oil-tight device
- Full heavy-duty contact rating
- Pressure connections eliminate internal wires
- Clearly marked terminals for easy wiring
- Button guard available to prevent accidental operation
- Full range of voltage ratings
- Choice of 6 color caps
- Same single-hole mounting as other oil-tight units

A *Complete* LINE OF OIL-TIGHT CONTROL UNITS

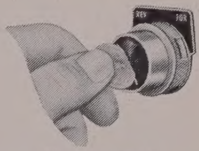


Standard Button



Mushroom Button

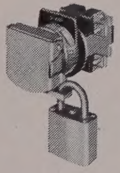
Selector Switch



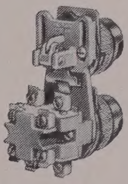
Coin-operated Selector Switch

Key-operated Selector Switch

Stop Button Lockout



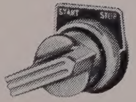
Start Button Lockout



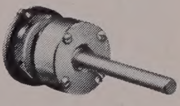
Maintained Contact Attachment

Push-to-Test Pilot Light

Selector Switch Padlock Attachment

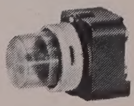


Selector Switch with Gloved Hand Operator

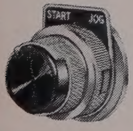


Wobble Stick Operator

Extended Guard Button

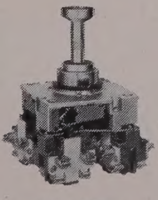


Pilot Light

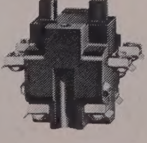


Selector-Push Button

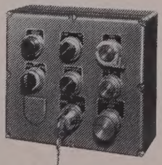
Neoprene Cap



4-Position Joystick Operator



Wide Range of Contact Blocks



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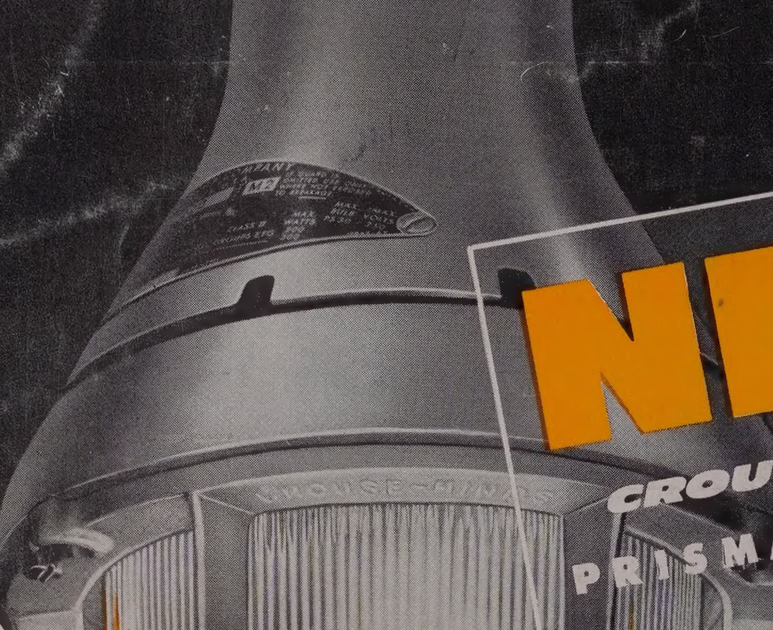

NEW CROUSE/HINDS PRISMATIC GLOBE

adds greater value to CROUSE/HINDS EV Series explosion-proof lighting fixtures

Now, at no extra cost to you, this new Crouse-Hinds Prismatic Globe reduces troublesome glare while increasing "seeing" brightness. Provides more efficient working light, by softening and distributing the light evenly – without reducing the amount of usable light.

By eliminating "hot spots", the Crouse-Hinds Prismatic Globe reduces eye-fatigue . . . especially important in areas where reduced worker efficiency is itself a potential hazard. Prisms are inside the globe to keep the exterior dust-free. Prismatic Globes are furnished with 100, 150, 200/300 and 300/500-watt sizes of Crouse-Hinds EV Series explosion-proof lighting fixtures.

- **Reduces glare**
- **Gives uniform brightness**
- **Eliminates normal "hot spot" below fixture**

Crouse-Hinds Series EV Explosion-Proof Lighting Fixtures are easy to install and relamp, provide high lighting efficiency in areas classified as Class I hazardous by National Electrical Code. Available in choice of mountings, with a variety of reflectors for incandescent and mercury-vapor lamps.

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